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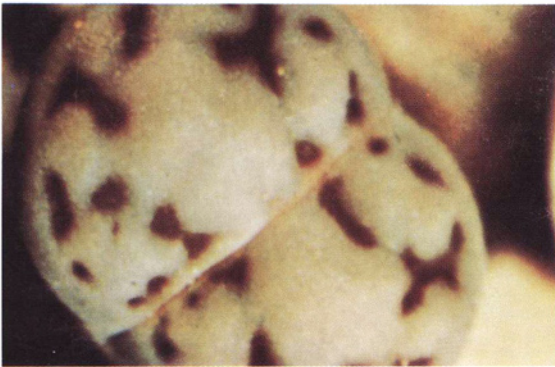
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LITHOPS



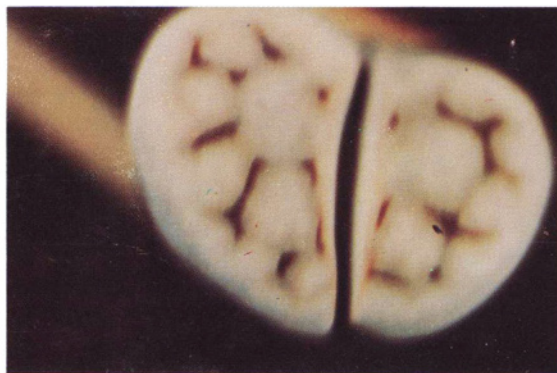
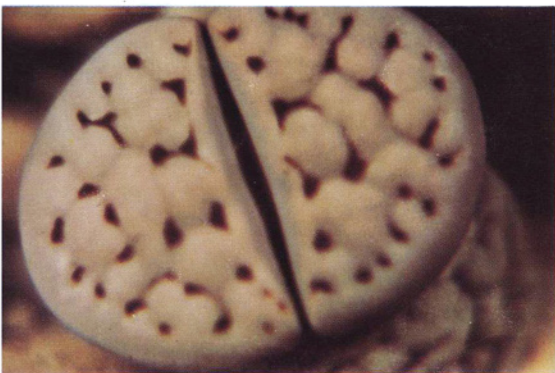
by
David L. Sprechman

With
Anatomical Study
by Prof. Chester B. Dugdale



Geographical Survey
by Prof. Desmond T. Cole

Analytical Key
by Prof. Dr. H. W. de Boer



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*Rutherford * Madison * Teaneck*

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Fairleigh Dickinson University press

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To
Yvette

Foreword

The efforts of dedicated botanists and researchers in the field have resulted in a number of excellent works concerning the genus *Lithops*. However, by reason of their anatomical construction and small size, these plants do not lend themselves readily to a generally acceptable taxonomical classification of their species and varieties.

In the words of the famous Professor Dinter, “It is extraordinarily difficult to separate correctly as species, the forms of a group who have no more than the essential vegetative organs, namely two leaves; for flowers, fruit and seeds, which are so useful—are here often useless when seeking to express in language the distinctions in the *Sphaeroidea*. It is difficult enough to put into words the differences in the nature of the surface of the leaves, that is, the type of smoothness of the cuticle, the type of humping, grooving and distribution of the colorings of any markings present, so that misunderstandings are excluded.”

The eminent botanist Professor Schwantes of Kiel, in his fine book (*Flowering Stones*, 1957, page 194) states: “It should at once be clear that it is very difficult to recognize these plants from descriptions alone. One must have not only illustrations, but for preference, comparable pictures of the most important forms which constitute the species.”

The monograph *Lithops* by Professor C. G. Nel, a book that no collector can be without, goes far in alleviating this situation. The plates consist of hand colored drawings of *Lithops*, superbly done, and to a point, are most useful. Fine black and white reproductions of *Lithops* are to be found scattered throughout many works and journals on succulents, but full colored photographs are seldom to be seen.

For the serious and ardent collector, a nameless or mislabeled plant in

his collection is a source of constant irritation, and the attempt to assign a name to a plant by comparisons with "written descriptions" or inadequate pictures can often prove most frustrating. Since color is such an essential characteristic in the delineation of the species, a good colored photograph can be most useful to this end. The remarks of the English botanist Brian Fearn in the *Bulletin of The African Plant Society* (Vol. 1, No. 1, April 1966) states the need precisely: "Color is an extremely variable character and one which is difficult to portray in words. A color photograph, correctly color balanced, can convey an impression immeasurably better than wordy descriptions. Color is difficult to apply to distinguish species, but it is important provided it is in conjunction with all the other characters such as form and shape of markings, size and form of the window, spots, lines and size of the fissure." This then, is the purpose of this effort—to portray in full color as many different aspects of the various species as I have been able to collect and bring under the camera lens.

It is not to be expected that every species and every variation of each species is contained herein. This is regrettable, but I trust understandable in the light of my limited capacity for acquisition of plant material.

After much consideration I have decided to use the nomenclature as favored by Dr. H. W. de Boer of Haren, Holland. He has devoted many years to the study of Lithops and has painstakingly cultivated, grown from seed and flowered, populations of Lithops. Only after extensive seed-trials has he made his observations and come to his conclusions concerning the acceptability and validity of many of the species as heretofore constituted. This practice of making observations from large populations rather than single specimens, makes for a more acceptable separation of the species and their varieties and gives more than a transitory value to the work.

By following Dr. de Boer, I do not intend the denegation of all of the findings that have gone before. It is only that I must give consideration to the latest work on the subject where new facts, new data, new discoveries, have compelled new attributions and assessments. That these new findings will in turn undergo future scrutiny and change is to be expected, but such a prospect is no cause for dismay or consternation, rather is it an evidence of the continuing growth of knowledge of this subject, and it must remain a challenge to researcher and collector alike.

The difficulties entailed in making proper identifications of Lithops species are further multiplied when consideration must be given to the changes that occur (in varying degrees) in the colorations and markings of the lobes during the year as well as during the entire life span of the plant. A seedling or young plant can be quite different from an older and more matured specimen. There are also the differences in the colorations and markings of plants of the same species which are growing in habitat and of those under cultivation. All these factors—time of year, age of plant, and history of growth—are to be taken into account when making observations for com-

parisons. Since a new pair of leaves is formed yearly, care must be taken to make observations from the new or emerging lobes and not from the old or dying pair of leaves which enclose the new growth.

The photographs herein, except where otherwise noted, were taken by myself of plants in cultivation and, whenever possible, when they were full blown and turgid. It is at this state of their growth that the distinguishable characteristics and colors can best be observed.

A knowledge of the habitat of the plants is helpful, in that it assists the observer in relating the characteristics of the species, one to another, and of the connection or affinity that one species may have with another. To this end, with the kind permission of Dr. H. W. de Boer of Haren, Holland, I have included herein a map of the portions of Africa where lithops have been found. Each species (where habitat is known) has been keyed to an area therein.

I wish to acknowledge and express my thanks to Professor Desmond T. Cole of Johannesburg, South Africa, for his kindness in permitting the use of a series of his excellent habitat pictures and also views of plants from his personal collection. They bring to the collector an awareness of the changes and sometime startling differences that are to be noted between plants in habitat and in cultivation.

Professor Cole has for many years made numerous field studies of the growth habits and geographical distribution of this genus and I am therefore deeply gratified and pleased to include an article on this subject by so knowledgeable an authority.

Professor Chester B. Dugdale of Fairleigh Dickinson University, Rutherford, New Jersey, has contributed a most informative and valuable article on the anatomical structure of the Lithops plant, for which I extend my thanks and appreciation.

To Dr. de Boer, the world's foremost authority on the subject of Lithops, is owed a debt of gratitude by all for his many years of arduous work in the difficult task of classification, and by myself for valuable plant material and information he has so often supplied to me, and for his generosity in permitting me to include in this work his analytical key and photographs of recent attributions.

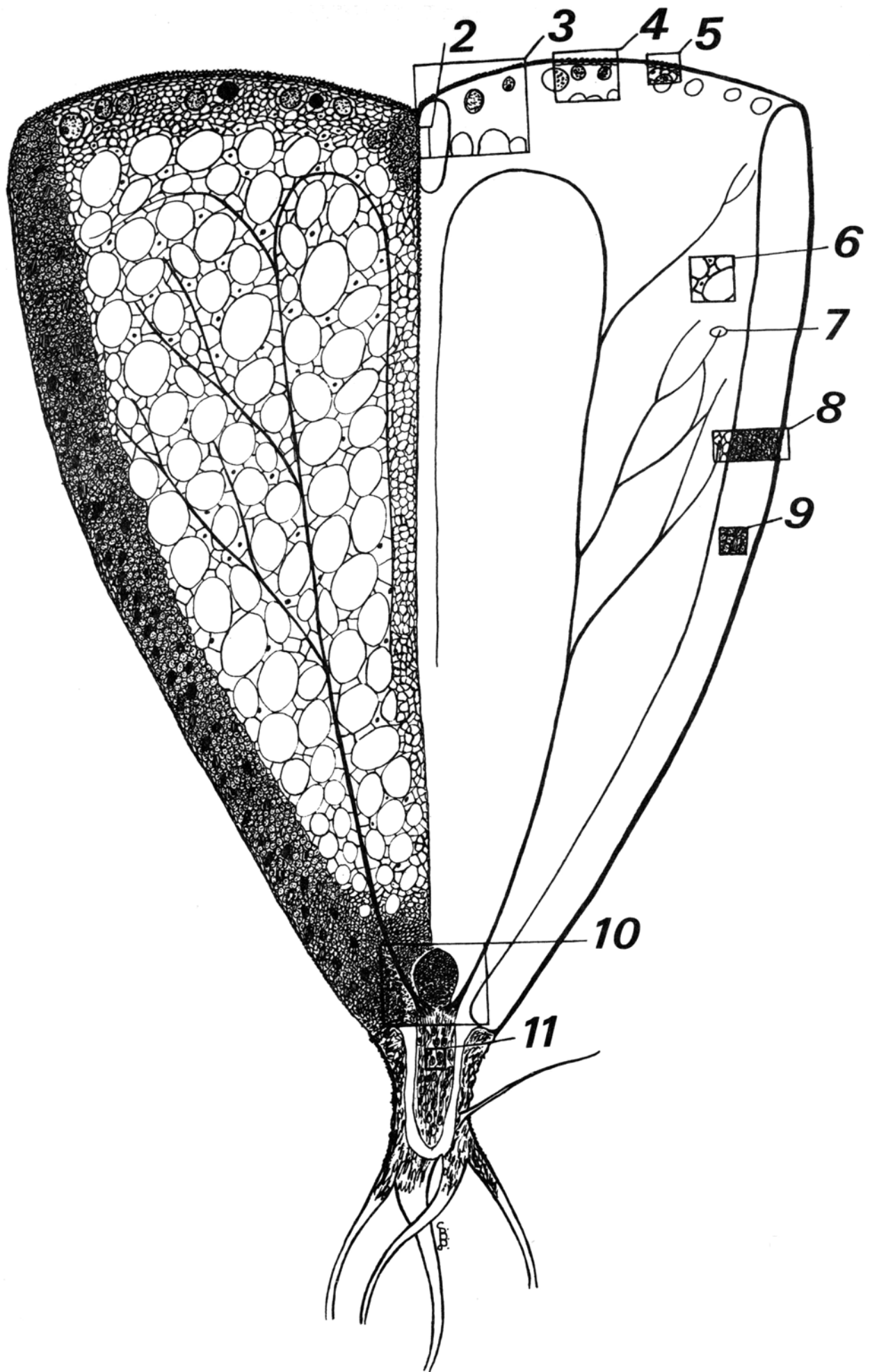
The collection and study of Lithops have given me many years of pleasure and satisfaction. The elusive colorings of the surfaces of these tiny plants afford constant delight to the collector. To capture these colors photographically has been a continuing challenge and the measure of my success in this regard must be found in the eye of the beholder.

D. L. SPRECHMAN

Contents

	<i>Page</i>
Foreword	
1 Lithops: Their Structure and Growth Cycle by <i>Professor Chester B. Dugdale</i>	15
2 Lithops in Habitat by <i>Professor Desmond T. Cole</i>	21
3 An Analytical Key by <i>Dr. H. W. de Boer</i>	33
Bibliography	47
List of Plates	49
Index of Species	53
Plates	59

LITHOPS



Lithops: Their Structure and Growth Cycle

by Professor Chester B. Dugdale

At some moment in time the plant kingdom came into being. Since then, Nature has been in the business of producing plants—some useful, many beautiful, others odd, but all adapted to the particular environment in which they customarily grow. Adaptations are anatomical or physiological design-elements which in some special way enable a plant or animal to survive in a specific set of environmental conditions, in much the same sense that we say that a cross-cut saw has certain design-elements that enable it to effectively cut across the grain of wood. It logically follows that the more specifically a plant is adapted to a particular environment, the more difficult it is to maintain it successfully in any other environment. Lithops are exquisitely adapted to the rigors of the hot dry climate of the Orange River Basin of South Africa. Herein lies their beauty, their uniqueness, and the challenge of their culture.

An analysis of the desert environment shows that it is characterized by an over-abundance of sunlight, heat, and wind, and a shortage of water and humidity. The net effect of the interaction of these conditions is a high rate of water evaporation—a process which, when related to the loss of water from a leaf, is called in botany, transpiration. For an organism to lose water more rapidly than it can be acquired can lead only (like spending more

money than one earns) to disaster. However, if Nature (or Natural Selection) were to produce a plant so water-tight that none of its moisture could be lost, that plant would surely die of suffocation, because the passageways (stomata) that permit water to escape from leaves are the same ones through which vitally-needed air enters. One might call this: The dilemma of leaf design.

The anatomical structure of the Lithops plant, then, embodies those adaptational design-elements which serve to protect it from the excessive transpirational loss of water to be expected in a hot, dry, and windy desert climate. Its body consists of two inverted, hemi-conical, water-storing leaves whose general plan is shown in the drawing presented on page 14. These leaves are attached at their apices to a very short cylindrical stem that is difficult to delimit precisely. This stem imperceptibly grades into a well-developed root system. In the field the plant grows well-buried in the rocky soil. This protects most of the abaxial surface from the direct rays of the sun and it also prevents the wind from passing over this surface which, incidently, bears most of the stomata. Thus shielded from the sun and wind, the transpirational pull out of the leaf is greatly reduced. However, when Lithops are cultivated by hobbyists living in more moderate climates, the plants are necessarily grown with more of their bodies exposed, lest they suffer from an adaptationally-induced lack of fresh air and sunlight.

The further study of the anatomical structure of Lithops leads one to the interior of the leaf. With razor blade and microtome knife, the investigator proceeds. A longitudinal section removed from the body of a Lithops shows how different it is from a "typical" leaf. Compare figures I and II of the colored plates and see also the photomicrographs on pages 17 and 18 that show the cellular structure of the numbered areas of the drawing. In the leaves of the common privet, *Ligustrum*, which we can take as a rather typical mesophytic leaf, the surfaces are covered by a single layer of moderately heavy-walled epidermal cells. These, plus the waxy cutin which covers them, are sufficient to control the water loss under their normal growing conditions. Just beneath the epidermis is a layer or two of palisade cells containing most of the leaf's chloroplasts. These are advantageously located for utilizing the sunlight in the process of photosynthesis. In comparison, however, note that the chloroplast-bearing cells of the Lithops are found almost wholly on the inner surfaces of the walls of the leaf as indicated by the green areas seen in figure I. Before light can strike these chloroplasts, it must pass through the epidermis of the top surface and then it must pass through the many water-storing cells of the leaf's central core. Furthermore, because of the cone-like shape of the Lithops leaf, the more directly overhead the sun is, the deeper its rays have to penetrate through the water-containing cells to reach the chloroplasts. The weaker slanting rays of the early morning and late afternoon sun, however, strike those chloroplasts located higher on the sloping walls of the leaf. It should also be noted that

The numbering of the illustrations on this and the following page corresponds with the system used for the drawing on page 14.

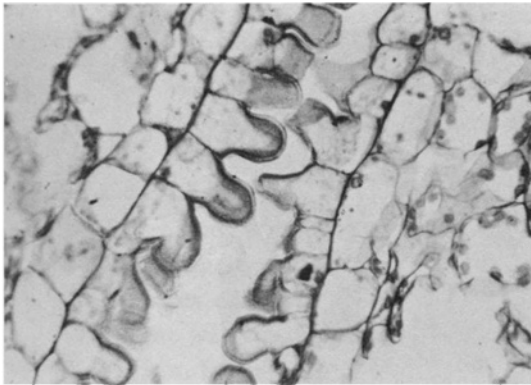


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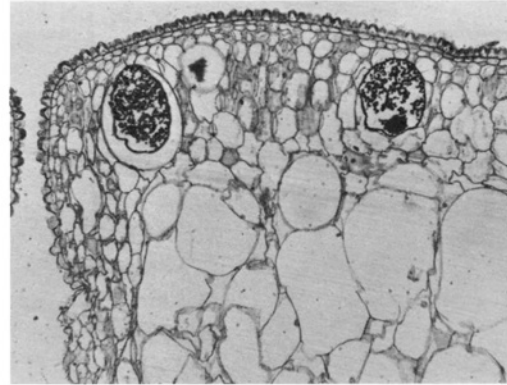


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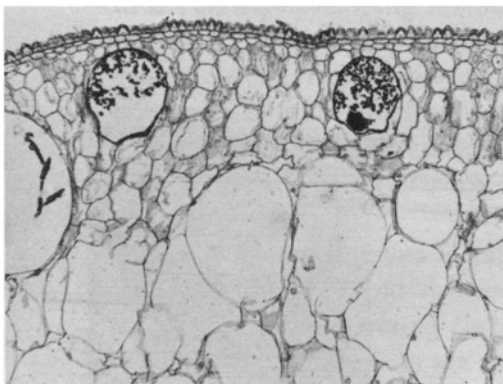
Longitudinal section of plants showing general structure and veining.



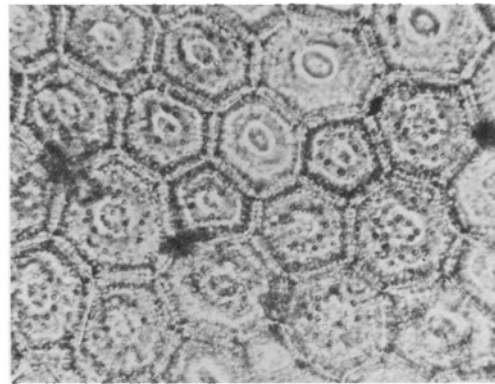
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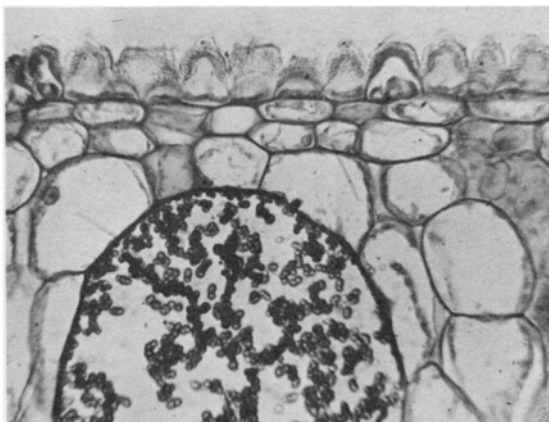


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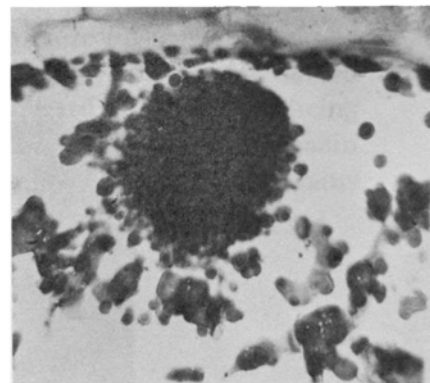


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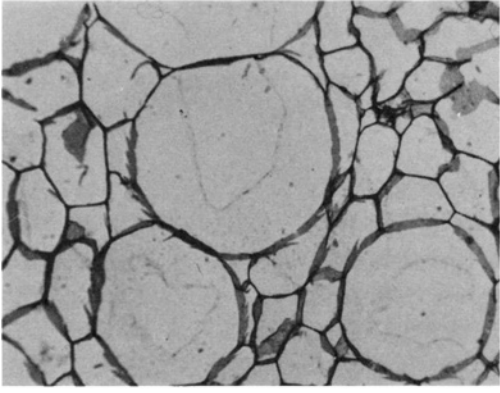
Chromoplasts found beneath epidermis.



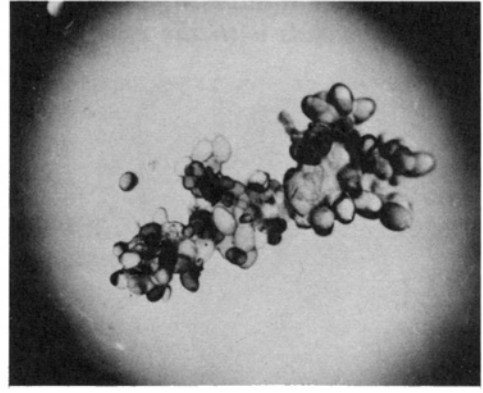
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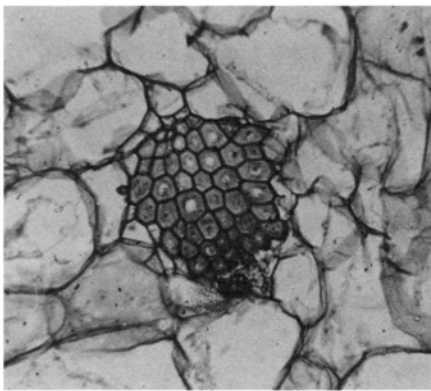


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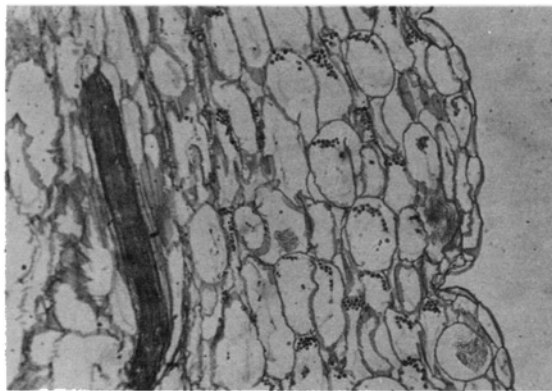


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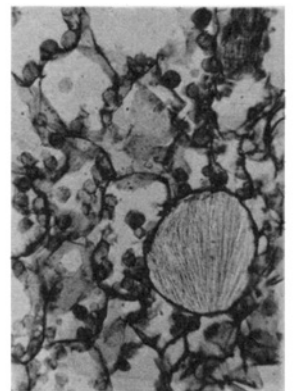
Water-storing cells.



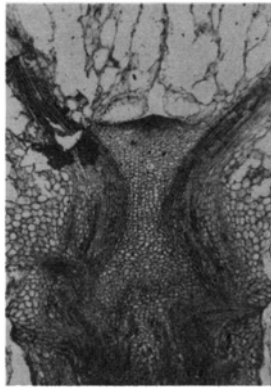
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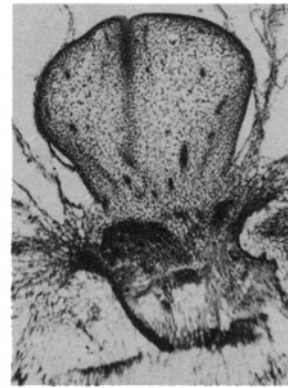
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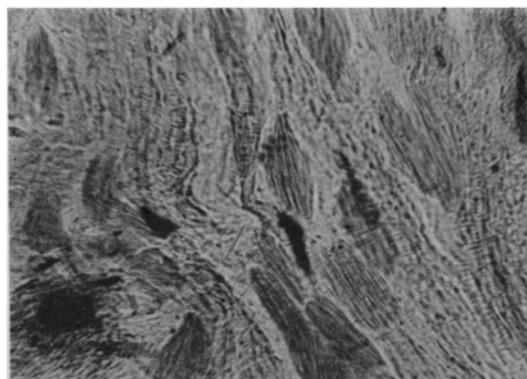
9.



10a.



10b.



11.

not all of the top surface of the plant is translucent; at least some of it is opaque and thus no light at all is permitted to enter in those areas.

Another striking feature of the internal anatomy of the Lithops plant is the presence of fairly large cells containing a solution of tannin. Unfortunately, the chemistry of tannin and tannin-related compounds is not completely known and hence the adaptive value of these cells is also not known. It has been suggested that tannins may act as absorbers of ultra-violet light, as sources of reserve food supply, or that they may play a role in oxidative metabolism. However that may be, the tanniniferous idioblasts, as they are called, are present in almost all species of Lithops, and their location in the leaf and in the sepals of the flower suggests, at least, that they constitute another obstacle to the free passage of light into the plant. Figure III shows one of the various patterns in which tanniniferous idioblasts occur.

A mature Lithops plant growing in the field normally produces two new leaves each year-although sometimes the meristematic region may split so that four new leaves are formed. If this happens several times, a multi-headed plant will result.

The new leaves start as a minute mound of cells growing from the top of the stem which was previously described as being located down at the apices of the leaves. As these new leaves gradually enlarge, it is believed that water is withdrawn from the older leaves and is transferred to the new ones. In a simple experiment, a dye was injected into one of the older leaves of a growing Lithops plant. An hour afterward the plant was dug up and cut open. The dye had travelled down into the stem and then up into both of the newly-developing leaves, thus demonstrating that a pathway for the transfer of fluids from old to new leaves does exist. (See figure IV). As the growth of the new leaves continues, the old leaves gradually shrink and wither away until finally all that remains is the dried-up epidermal skin of last year's plant. Within this skin can usually be seen the dessicated remains of the tanniniferous idioblasts, now flattened disks of brownish-red pigment.

Once a year the mature plant produces either a white or a yellow flower. The color depends on the species to which the particular plant belongs and the time of blooming correlates with the rainy season in their habitat. A number of the flowers are shown in the color plates that follow and they need not be described here. If the flowers are successfully cross-pollinated, a very intricately constructed seed capsule develops. These capsules, as well as the flowers from which they came, have their component parts occurring in multiples of five, six, or seven. The seeds seen in the six chambers of the capsule, shown in figure V, are held in place by little lids as in the closed capsule illustrated in figure VI. When a drop of water lands on the closed capsule, the little covers rather quickly swing upward and outward, being activated by a hygroscopic mechanism. In Nature, the capsules remain closed after they develop. Then the first rain drops of the ensuing

rainy season cause the capsules to open and the seeds are washed into the surrounding soil. If moisture and warmth persist, germination of the seed occurs within a few days. However, since in their habitat periods of prolonged drought are rather common, another useful adaptation has evolved. Lithops seeds remain viable for several years—eventually the rains will fall and a new generation will get its start.

While all of the features of the Lithops plant so far described contribute to its success as a desert dweller, none of these anatomical details are quite as fascinating as are the patterns of texture and color seen on the top surface of many of the Lithops species. A study of the pictures of plants growing in their native soil which are presented in the main body of this book shows that many Lithops exhibit a spectacularly high degree of protective mimicry. In most species the plants match their backgrounds in at least one main color and often in a second color as well. In addition, surface textures, sheen, and line patterns very closely conform to those seen in the surrounding soil, rocks, and vegetation. It is no wonder that Lithops have been called “belly plants” to indicate that even an experienced collector may not see plants growing at his feet—only if he travels “on his belly” can he hope to avoid overlooking these little gems of the South African veld.

Lithops in Habitat

by Professor Desmond T. Cole

As far as it is presently known, the genus *Lithops* is restricted in distribution to South West Africa, three provinces (Cape, Orange Free State and Transvaal) of the Republic of South Africa, and one locality in Botswana (formerly Bechuanaland Protectorate). The site in Botswana, representing *L. lesliei*, is situated in the Lobatsi District, near the Cape and Transvaal borders. It is probable that further research will reveal the existence of other colonies of *L. lesliei* in Botswana, near the eastern and southeastern borders, where the terrain is similar to that in the adjacent northern Cape and western Transvaal, but the occurrence of *Lithops* in the sandy Kalahari Desert area of central Botswana is unlikely.

In northern Transvaal *L. lesliei* occurs near Pietersburg and has been reported also in the districts of Louis Trichardt and Messina, the latter near the Rhodesian border. It is possible, therefore, that this species may yet be found in southwestern Rhodesia. In the south it occurs at several places within 30 to 60 miles of the border of Lesotho (formerly Basutoland), so it may yet be discovered in that country, near the northwestern border where rise the foothills of the lofty Maluti Mountains. However, *Lithops* have not yet been discovered in Natal, Swaziland, Portuguese East Africa and the eastern Transvaal, and their occurrence in these "lowveld" regions, east of the Drakensberg range, seems unlikely.

In South West Africa (S.W.A.), *L. ruschiorum* has been reported from Sesfontein and even further north in the Kaokoveld, so this species may ex-

tend into southwestern Angola, while *L. pseudotruncatella* occurs within 100 miles of the eastern border of S.W.A., and may yet be discovered further to the east, within Botswana. Though restricted, as it essentially is, to South West Africa, and the Cape Province (C.P.), Orange Free State (O.F.S.) and Transvaal (Tvl), the total area of distribution of the genus is nevertheless of the order of 500,000 square miles.

The range of individual species and varieties varies enormously. For example, *L. weneri* is reported from only one site in the Erongo Mountains of S.W.A., and *L. glaudinae* is known to me at only one site, about 50 miles S.W. of Postmasburg, C.P. The same can be said of a number of varieties, e.g., *L. turbiniformis* var. *subfenestrata* (near Prieska, C.P.), *L. pseudotruncatella* var. *volkii* (south of Windhoek, S.W.A.), *L. lesliei* var. *minor* (S.W. of Swartruggens, Tvl), etc. Many species are fairly widely distributed, however. *L. lesliei*, in its several varieties, scores top grade with a range of about 100,000 square miles in the Transvaal, O.F.S. and adjacent areas in the northern Cape Province. I have personally confirmed its occurrence at 32 sites within this vast area, and have reports of another 50 sites.

Of this total of over 80 localities, the distinctive varieties of *L. lesliei* (var. *minor*, *venteri*, *hornii*, etc.) account for only about a dozen. Within its vast range, therefore, *L. lesliei* is remarkably uniform, and this seems to suggest that it is a relatively young species, whose diffusion has taken place in relatively recent times, so that it has not yet had time to diversify and develop distinctive varieties. Our assumption here is that the evolution of distinctive varieties within species results from some process of natural selection; hence, the greater the area of distribution with relatively few recognizable varieties, the less time there has been for the process of natural selection to operate.

The area of distribution or range of several species is relatively discrete, as in the case of *L. lesliei*, *L. localis*, *L. salicola*, *L. optica*, *L. vallismariae* and *L. pseudotruncatella*; but there are also many instances of overlapping of range, e.g., *L. hallii* and *L. turbiniformis*, *L. aucampiae* and *L. turbiniformis*, *L. ruschiorum* and *L. gracilidelineata*, *L. gesinae* and *L. schwantesii*, *L. marmorata*, and *L. herrei*, *L. marmorata* and *L. helmutii*, etc. It is therefore not unusual to find two or even three quite distinct species in relatively close proximity, within a few miles of one another, or even less. Near Namies, C.P., *L. olivacea* and *L. fulleri* occur in sites less than a half mile apart; south of Prieska, C.P., *L. hallii*, *L. turbiniformis* and *L. verruculosa* occur within a radius of less than two miles; near Hopetown, C.P., *L. aucampiae*, *L. marginata*, *L. hallii* and *L. salicola* occur within a radius of ten miles, the latter two only a mile apart.

Despite the overlapping of ranges, and the occurrence of different species in relatively close proximity, we have no evidence—as yet—of different species actually growing together. Near Helmeringhausen, S.W.A., *L. gesinae* var. *annae* and a form of *L. schwantesii*, grow almost side by side

on the same flat stony ridge, at one point only twenty yards apart, but the two colonies are discrete, not mixed, and examination of the plants in both colonies revealed no evidence of hybridization. Some hybrids of different species of *Lithops* have been produced in cultivation, but so far we have no clear indication that hybridization occurs in nature.

The size of individual sites or colonies of *Lithops* also varies enormously. In some cases, e.g., *L. weneri*, the sites are reported to be narrow strips or small areas of less than 10 square yards in extent; in others they extend over many thousands of square yards. Near Namies, C.P., *L. fulleri* occurs almost continuously over an area of at least a half mile in length and two or three hundred yards wide. The density of plants in any particular colony varies considerably from one locality to another, but apparently also according to species or variety. It is not unusual, for example, to find *L. lesliei* or *L. aucampiae* fairly thickly clustered together, sometimes in patches containing dozens, as many as sixty, per square yard, so that it is difficult to walk over the site, or at least portions of it, without treading on plants. On the other hand some varieties of *L. pseudotruncatella*, e.g., var. *pulmonuncula* and var. *dendritica*, seem to occur solitarily, infrequently clustered, and with individual plants often several yards apart. There can be little doubt however, that this variability in density is also related to climate, soil conditions, topography of the site, prevalence of predators, etc.

There is a very considerable amount of variation in the size of individual plants of any particular species, not only in different localities, but also in the same colony. The variation in size is most conveniently expressed in terms of the number of heads (plant bodies or pairs of leaves) on individual plants with a single root, and of the dimensions of the head or heads, the latter being based on the diameters of the top surface, and the length from the top surface to the base or point of junction with the root.

Some species and varieties are predominantly monocephalous (single-headed). These include *L. gracilidelineata* and *L. pseudotruncatella* var. *dendritica* and var. *pulmonuncula*, in which the occurrence of specimens with two or more heads is infrequent or rare. In most species, however, plants with two to six heads are common, and in a number of cases polycephalous (multi-headed) plants predominate. Polycephaly is mostly highly developed in *L. salicola*, *L. marmorata* and *L. olivacea*, in which plants may have twenty heads or more, while ten heads or more are not particularly unusual in *L. aucampiae*, *L. insularis*, *L. lesliei*, *L. glaudinae*, *L. Karasmontana*, *L. localis*, *L. turbiniformis*, etc.

The size of individual heads varies considerably from one plant to another, and very often even on the same plant. This variation may be genetically determined to some extent, but there can be little doubt that several other factors also are involved. Unprotected plants are generally smaller in size than those which are partially shaded by shrubs, grass or rocks. Plants growing under shrubs are usually larger also because the soil is richer, con-

taining a good deal of humus and leaf-mould; and plants growing in very stony areas are usually smaller than those in areas with less stone and deeper soil. In any one site the ecological conditions may vary considerably within a matter of yards, feet or even inches, and the size of the plants varies accordingly. Very frequently too, as one might expect, the individual heads on polycephalous plants are smaller than those on plants with fewer heads, for approximately the same amount of moisture and nutrition from the soil is available to the plant, whether it be monocephalous or polycephalous.

Some species of *Lithops* are, on average, relatively small in size, others much larger, and the average size does not appear always to be related to rainfall. Thus *L. aucampiae*, probably the largest species, with surface dimensions up to 53 x 37mm., and 55mm. in length, occurs in the northern C.P., where the rainfall is 15 to 25 inches per year, while *L. lesliei*, with an annual rainfall of 20 to 35 inches, is generally a good deal smaller, rarely exceeding 40 x 30mm. in surface dimensions and 40mm. in length. One of the largest forms of *L. lesliei* occurs in the northern Transvaal, near Pietersburg, where the annual rainfall is 5 to 10 inches less than in the southern Transvaal and O.F.S.

Other relatively large species are *L. turbiniformis*, *L. hallii*, *L. marmorata* and *L. pseudotruncatella*. It is nevertheless true that most of the smaller species, e.g., *L. optica*, *L. dinteri* and *L. weneri*, occur in areas of much lesser rainfall. Indeed, *L. optica*, whose habitat is the desert coastal strip north and south of Luderitz, S.W.A., rarely enjoys any rain as such, and is dependent for moisture mainly on mist and fog, which condenses on the little plant bodies and the surrounding pebbles and stones. It is interesting to note that, in habitat, *L. optica* infrequently has a long, well-developed tap-root, but more usually an extensive system of fine rootlets extending laterally, and often even upwards from the base of the plant towards the surface of the soil. This feature occurs also in several other species and varieties which grow in areas of very low rainfall.

Several of the larger species of *Lithops* have smaller forms occurring in restricted localities. One of these, *L. lesliei* var. *minor*, has been accorded varietal status; in habitat it rarely exceeds 20 x 15mm. in surface dimensions, and is thus considerably smaller on average than all other forms of *L. lesliei*, excepting juvenile plants. There is also a small form of *L. olivacea* near Pofadder, C.P., and of *L. insularis* on the southern bank of the Orange River near Kanoneiland.

All species of *Lithops* shrink during the dry season, and even more after prolonged periods of drought; on the other hand, they fatten up and become much larger when well-watered—most *Lithops* in cultivation are probably better watered and therefore larger in size than they would be in habitat. However, *L. lesliei* var. *minor*, which we have had in cultivation for several years, remains proportionately smaller than other forms of this species, even

when watered more prolifically. The same is probably true in the case of *L. olivacea*, where, however, the disparity in size between the "minor" form and the typical form is not so striking as in *L. lesliei*. By contrast, the small form of *L. insularis*, whose habitat is extremely arid, seems to react fairly quickly to regular watering.

It is generally assumed that Lithops grow only in stony ground, but there are several striking exceptions to this, as there are to so many other generalizations about these fascinating little plants. *L. salicola* occurs in limestone ridges, but at several places also in alkaline "pans," shallow depressions or flats in which water may stand for weeks during the rainy season, and in which the top surface is a layer of clay about an inch in thickness. For weeks at a time, then, the plants may be submerged under water or protrude slightly from a sticky clayey morass, which subsequently dries, hardens and cracks in a myriad patterns. There are a few stones, up to about three inches in size, dotted about on the surface of these pans, but the substratum below the layer of clay contains no hard stone, only a leavening of fine soft shale.

Whereas *L. vallismariae* typically occurs on ridges covered with round transported quartz pebbles, among which, incidentally, the plants are exceedingly difficult to find because of their similarity in shape, size and color, there is at least one pan near Mariental, S.W.A., in which this species grows in conditions almost identical with those described above for *L. salicola*. Even more unusual is the type locality of *L. schwantesii* var. *nutupsdriftensis*, also a pan, in which the top layer of clay is less than half an inch thick, and there are no stones at all, either above or below the surface.

For the rest, there is an incredible variety of habitat types in which Lithops occur. Usually the sites are located on stony slopes and ridges, which provide effective drainage. The slopes are usually fairly gentle and strewn with small stones and pebbles, but are sometimes steep, rough and rugged, on rocky hillsides. The formations may incorporate limestone, sandstone, iron-stone, quartz, granite, shale, gneiss, schist, etc., in various forms and mixtures. The soil may be fine-grained and dense, hard and compacted, or relatively soft and loamy, sandy or foliated. A large proportion of the sites which I have inspected, especially in the Cape Province and S.W.A., obviously contain a good deal of mica. In most cases, probably, the soil pH is more or less neutral, but it is alkaline in limestone areas and maybe acid in others. In the Transvaal, O.F.S., northern Cape and central parts of S.W.A., *Lithops* often occur in fairly well vegetated areas, in grasslands, or shrubby or bushy areas, or under trees, and the soils contain a good deal of organic material. In the more arid regions of the Karoo, western Cape and southern and western parts of S.W.A., however, there is very little vegetation and the soils are mainly mineral in composition.

To some considerable extent there is a correlation between individual

species of Lithops and the nature of their habitat in terms of topography, type and color of stone and soil, etc. The experienced fieldworker learns to recognize these features, and, in areas where two or three species occur in close proximity, can predict which of them is likely to occur in a given locality. For example, south of Prieska, C.P., where *L. hallii*, *L. turbiniformis* and *L. verruculosa* occur in several sites within a radius of a few miles, the habitats are quite distinctive. One would expect to find only *L. turbiniformis* on the low hills, in quartz; only *L. hallii* on the limestone ridges and slopes; and only *L. verruculosa* on the fairly flat areas with dark stones and transported gravel. But, to be sure, there are sometimes surprises in store for even the most experienced fieldworker.

The color of the soil varies from red through various shades of brown and grey to yellowish and near-white, while the stone manifests an even greater variety of color, including black and white and shades of blue and green. The colors of the soil and of the stones in any particular locality are not necessarily matched; in many localities, for example, white quartz occurs in very red soil. In such cases, where the colors of the soil and stone contrast strongly, the predominant color of the plants may match either the soil or the stones. For example, *L. fulleri* var. *ochracea* occurs among white quartz chips in red soil, against which background the predominantly reddish brown plants are very difficult to see; whereas the near-white *L. pseudotruncatella* var. *volkii* blends with the milky white quartz of its habitat, and not with the dark grey soil. In other cases the plants may incorporate the color features of both soil and stone; *L. bromfieldii*, red with yellowish-white margins and markings, blends with white and red-stained quartz in red soil.

Whatever the color of the plants, they nearly always blend with their background so effectively as to make them very difficult to see. On many an occasion we have traversed an area several times without success, then, having eventually spotted a plant, one squats in order to examine it more closely or to prize it out of the ground, and suddenly several others come into perspective. The only really effective way to search for these plants is on hands and knees, but for the true addict, "lithoparian's knee" and lacerated hands are among the accepted hazards and are not considered too high a price to pay.

Different heads on the same plant generally manifest similarity in shape, color and markings; their top surfaces are usually all more or less equally flat or convex, with more or less the same shade of green or grey or brown or whatever, and with more or less the same shape of window and pattern of islands or other markings. Thus if the characteristic of the plant is a large open window, with few or no islands, then all of the heads usually manifest this; if the characteristic is a close-knit pattern with numerous islands or other markings, then, likewise, all of the heads usually manifest this.

Very often too, the islands or other markings have more or less the

same shape, and occur at approximately the same position on each of the two lobes. However, many exceptions do occur. I have, for example, a ten-headed specimen of *L. olivacea*, on which two heads have completely open windows with no marking whatever, and the other eight have a few small islands, but only on the larger lobe in each case. If the plant is healthy, the characteristic coloration and markings are retained year after year, though the coloration is brighter at the beginning of the annual cycle or when the plant is well-watered and turgid, but duller at the end of the cycle, or when dry and shrunk; the coloration is also affected by sunlight and shade.

In general, therefore, all the heads on the same plant manifest the same overall appearance, but, as with fingerprints, no two are exactly alike, as close examination will establish. Within any one colony however, there is a wide range of variation in size, shape, coloration and markings, and few specialists who have not seen Lithops in habitat can be aware how great this range of variation is. How much greater then, is the range of variation in a number of colonies of the same species, even excluding recognizable varieties—despite the fact that laymen or novices commonly react with “But they’re all alike” when introduced to a collection of nearly a hundred species and varieties!

One of the results of this great range of variation has been, I believe, an over-classification of species and varieties of Lithops, especially in the northwest Cape and South West African areas. In recent years at least nine taxa, originally described as species, have been reduced to varietal status or to synonymy under *L. pseudotruncatella*; similarly at least six taxa have been subsumed under *L. schwantesii*, five under *L. karasmontana*, three under *L. marmorata*, and so on. Despite this salutary trend on the one hand, there remains a tendency on the other to establish new species and varieties too hastily, very often on the basis of inadequate and unrepresentative samples. Whether by accident or by design, collectors sometimes gather and submit for classification selections of plants which manifest only certain of the range of features occurring in a newly-discovered colony, these features are assumed to be representative, and because of their apparent distinctiveness a new species or variety is published, only to be reduced to lesser status or to synonymy when more representative samples are collected. I have little doubt that by judicious selection of specimens, I could produce evidence for a half-dozen or more “new varieties” of *L. lesliei* or *L. auctampiae*, none of which, however, would be valid in the context of the total range of variation in these species.

Needless to say, the classification of Lithops is beset by other problems too. There is, of course, the perennial conflict between the “splitters,” pre-occupied with differences, and the “lumpers,” more concerned with similarities. Because the flowers and fruits of all the different species of Lithops are so remarkably similar, classification has been based mainly on the forms

and colors of the plants themselves, but these are composed of little more than one or more pairs of leaves, which are not normally considered by botanists to be taxonomically diagnostic. It might prove rewarding, however, to devote more attention to the study of flowers and seed capsules than has been accorded them to date.

Inevitably there is the further problem that apparently quite distinct taxa are discovered some considerable distance apart, and are described in all good faith as separate species, but the later discovery of intermediate forms with features common to both, reveals a previously unsuspected relationship. It is interesting to observe that, in my experience, such intermediate forms are usually also geographically intermediate, and I suspect that more of them will be discovered as the systematic survey of all potential areas progresses. It is my conviction then, that many more of the currently recognized species and varieties will yet be reduced to lower status or to synonymy, and it is regrettable that a good number of these changes should result from over-hasty publication of new taxa, and even of what are sometimes ill-considered revisions.

While there is no evidence that in normal seasons, Lithops constitute a regular item of diet for any animal, there is no doubt that several types of animals do eat them occasionally, and thus destroy them. Certain species of birds, notably the Bustards, are reported to eat Lithops, and it is probable that, in some areas at least, Baboons, Vervet Monkeys, Porcupines, Ground Squirrels, Rock Rats, Mole-rats, Gerbilles and other small rodents, do likewise. In times of drought however, when other food is scarce, Lithops and other small succulent plants are increasingly resorted to by such animals, and especially by the smaller rodents, as a source of food and moisture.

Sheep, goats, and smaller antelope, e.g., Springbok, quite often bite the tops off the *Lithops* plants when these protrude sufficiently from the ground. I have often found neatly scalped plants in habitats where these animals occur, the top surfaces reduced to concave layers of dried scar-tissue. However, unless attacked by some infection before the wound dries into scar-tissue, most of these plants survive to produce new heads the following season.

There are probably several species of insects too, which occasionally feed upon Lithops, and do so more frequently when other vegetable foods are in short supply owing to drought. I have occasionally found caterpillars of the cutworm type feeding underground on the plant bodies, but although Lithops are often to be found in close proximity to their nests and surrounded by their workings, neither ants nor termites of any sort appear to show any interest in them.

The Corn Cricket (*Hetrodes pupus*), which is widely distributed in the drier areas of southern Africa, seems to be very partial to Lithops flowers, which it devours completely, including the upper peduncle and the surrounding tissue on each side of the fissure, and thus leaving a cavity in the

top of the plant. In most cases this does not kill the plant, which remains disfigured by scar-tissue until the new head emerges the following season. The main destruction here, however, is that of the seeds and hence of future generations of plants. I have seen a number of colonies of Lithops, in which numerous scarred tops but very few seed capsules in hundreds of plants testified to the depredations of these omnivorous insects which are not true crickets, but are related also to the grasshoppers. It is probable that some of the grasshoppers and locusts also devour Lithops flowers.

By far the greatest depredator of Lithops is, needless to say, Man (*Homo sapiens*). The children of various African peoples (Bushman, Hottentot and Bantu), and no doubt adults too, occasionally eat these plants in order to assuage their thirst when out in the veld on a hot day. Several White farmers have told me that they similarly ate Lithops in their childhood days; others have related how, as children, they sometimes threw the soft, rubber-like plant bodies at one another. But a few plants eaten here and there, a few dozen used as ammunition in childhood games of battle, would have little effect on any well-established colony, and unless the colony were well-established and the plants easy to find, children would be unlikely to have the patience to search for them.

The two great menaces of Lithops in habitat are the succulent collectors and the "march of progress"—industrialization, Western civilization—the pernicious blight which surges into the most remote areas and destroys, mutilates, transforms and generally wreaks havoc on all of Nature's creations in its path.

Modern farming produces concentrations of cattle, sheep, goats, etc., which, in several localities, have tramped out colonies of Lithops, or poisoned them with urine and manure. The sites on which these plants grow are usually unsuitable for cultivation of crops, but they are often in the way of construction of dams and other irrigation projects, both small and large in scale. In several areas, urban and industrial developments (houses, factories, mines, etc.) have exterminated colonies of Lithops; similarly the construction of roads, highways, railroads and airfields has brought in the destructive bulldozer.

The eradication of a colony of plants may arise not only because it chances to be in the path of a projected highway, for example. The construction project may have repercussions miles away, where happens to be a hillside covered with pebbles, gravel or quartz chips of just the size and type required for metalling the foundations of the road, and so come the bulldozers, to scrape away the top six inches containing the desired metal, and of course the Lithops. Thus Lithops have been eradicated in recent years; for example, a colony of *L. lesliei* near Stella, C.P., and the type locality of *L. fulleri* var. *ochracea* near Upington, C.P. Another colony of *L. lesliei* is the victim of modern Man's pre-occupation with war, and, more than twenty years after the end of the war to end wars, is being torn

and trampled by the tracks of tanks milling around in mock battle at the armored vehicles training ground near Potchefstroom, Tvl.

Nevertheless, the greatest menace is the collector, of which there are several types. A few are content and happy to gather an adequate sample of the plants, to establish in a pot or tray, and to cherish in their own collections. A number, however, have commercial connections and interests, and these have eradicated many a colony, collecting not a dozen or twenty plants, but hundreds, by the sackful, for sale and personal pecuniary profit. Many others do not have commercial interests, but suffer from a dread disease, an insatiable passion to dig out every plant they can find. These also collect plants by the sackful, and have eradicated many a colony of Lithops. Usually they lack the time to plant out all of the specimens acquired, and the bulk of them are left to rot; or they lack adequate accommodation for so many plants, and the bulk are put out in the garden, to rot in a rainfall greatly exceeding that of their habitat; or they lack the time and knowledge to care for their plants properly, and the end result is again the same—wholesale death.

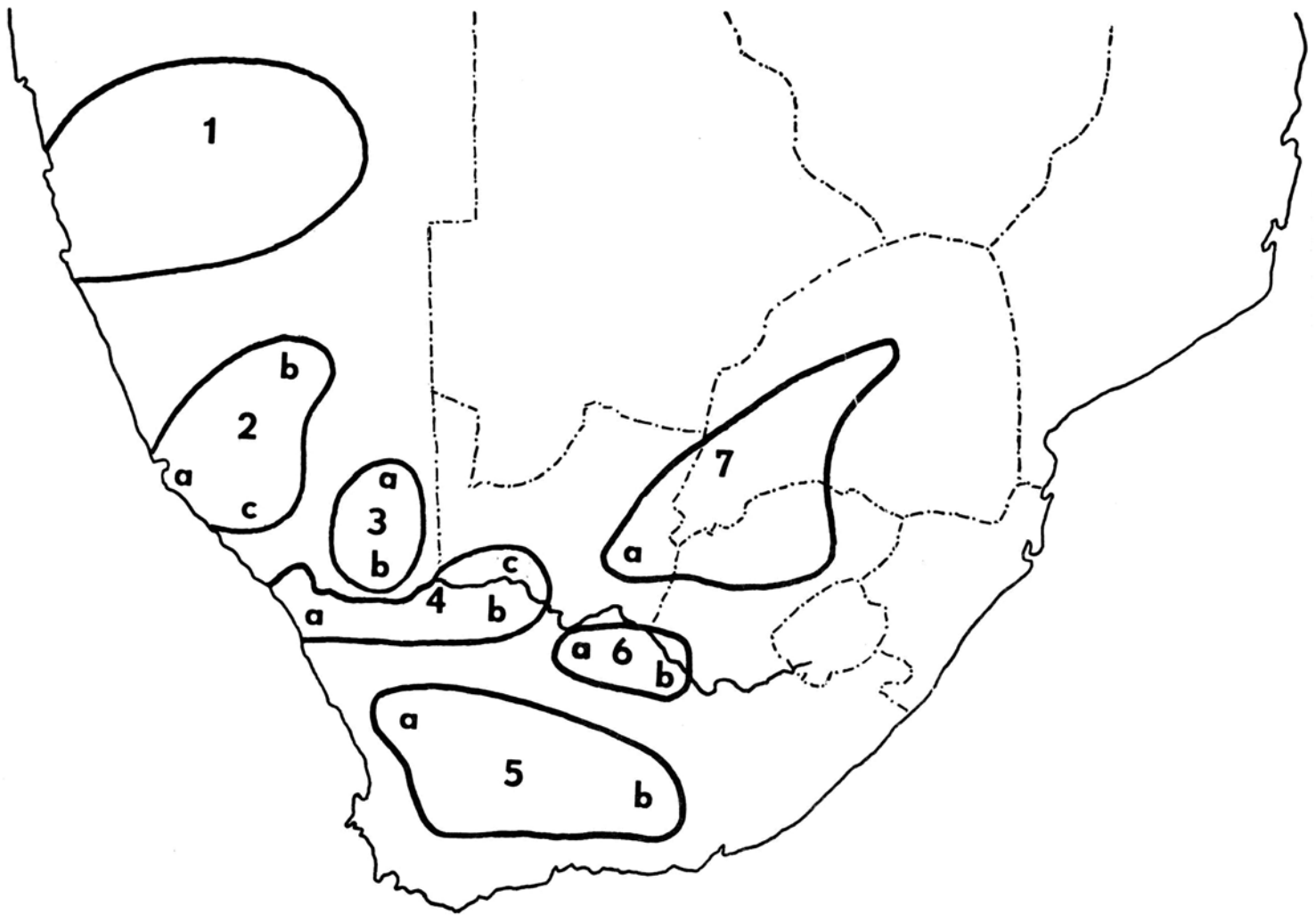
Lithops are, of course, rigidly protected throughout South Africa, and may not be collected without a permit from the relevant provincial authority and also the written authority of the landowner. But, as is so often the case, the law is an ass. On the law-abiding it imposes almost intolerable restrictions, but it provides no effective control over the wholesale collection, eradication, sale and export of Lithops by unlicensed and unauthorized persons.

In this brief survey, only some of the many interesting features and aspects of Lithops in habitat have been touched upon. Several of the statements and observations made here could apply equally well, of course, to various other genera of South African succulent plants. On the other hand there are a number of generalizations about the genus as a whole, or about individual species, and it must be emphasized that these should not be applied indiscriminately, for so much remains yet to be learned and discovered about these plants, so little can be stated with certainty at present. Among the most striking and fascinating features of this genus is its remarkable uniformity, within which is nevertheless, an incredible range of variation, an amazing and endless diversity. This is very frequently true of their habitats too.

Lithops occur at altitudes ranging from just above sea-level, a few hundred yards from the water's edge, to almost 8,000 feet; they occur on flat plains, on gentle inclines, on rough and precipitous slopes; they occur in pans, on low ridges, on hill tops, on mountain summits; they grow in clay, in sand, in humus, in stony soil, in narrow fissures between rocks; they occur in the most arid areas where it hardly ever rains, and in well-vegetated grasslands and bush country with an annual rainfall up to 35 inches.

Infinitely more variable are the colors and color-combinations of the

plants themselves and their patterns and markings, with dots and freckles, lines and grooves, dendrites and filigrees, lacinations and convolutions. The old adage says variety is the spice of life. Just one of the reasons why Lithops have so great an appeal to the collector and student must surely be the unceasing fascination, the spice of life, provided by their endless variety.



1. Damaraland
2. Great Namaland
 - a. Luderitz-bay
 - b. Northern Great Namaland
 - c. Southern Great Namaland
3. South-Eastern Great Namaland
 - a. Karas-mountains
 - b. Warm bad
4. North Western Cape Province
 - a. Little Namaland, Little Bushmanland
 - b. Great Bushmanland
 - c. Gordonia etc.
5. Central Cape Province
 - a. Western part [van Rhynsdorp, Ceres etc.]
 - b. Central part [Graaf Reinet, Willowmore etc.]
6. Northern Cape Province
 - a. Kenhardt-division
 - b. Prieska etc.
7. Transvaal and adjacent provinces
 - a. Bechuanaland, Griqualand west.

An Analytical Key

by Dr. H. W. de Boer

The genus *Lithops* is well-known by amateurs and growers of succulent plants; a considerable number of species and varieties is in general cultivation. The plants mostly produce quite a number of seeds; sowing is not too difficult and the care of the adult plants is quite simple.

The most difficult question is the identification and recognition of the species and varieties; there is literature enough on this genus, but this seldom contains keys for identification, so the amateur is mostly not able to trace his collection.

The key published by Nel in his "Lithops" p. 166-173 is not suited for our purposes; the number of species and varieties has increased considerably and certain characteristics have been revaluated; moreover this key is prepared on specimens grown in the wild, whereas we have to do with plants grown in cultivation under West-European climatical conditions.

The authors have made an attempt to prepare a key on characteristics which are perceptible for everybody who has the patience to observe the plants conscientiously. Still some experience is needed because of the difficulty of describing colour shades etc. A good lens is indispensable.

Moreover the variability of the species and varieties is rather large, so it is necessary to examine several specimens; in many cases it will be hardly possible to base identification on just one plant.

The first mentioned author has made in his glasshouse extensive seed-trials in sowing *Lithops* species and varieties by thousands.

As a result it was possible to limit the number of species by treating many of them as varieties. One has to be careful of interpreting populations grown in cultivation; it is possible that the collector of the seed in the wild was unintentionally selective, picking up only the nicest and the most uniform specimens and thus the variation of the material in cultivation is not representative of the total variation in the wild any more.

Still there is a real chance that the variation in our cultivation does not differ too much from that at the natural localities; consequently we have not considered the above taxa as cultivars but as real varieties.

In the last few years a good many new localities of *Lithops* have been found; intermediates between many varieties are discovered, so it is possible that several taxa will have to be revalued in the future.

The key is built up on adult specimens in the summer; in winter the bodies are shrivelled too much and the colours are not characteristic in this state.

There are some terms to explain before using the key:

Window: a window is a transparent part of the top surface; sometimes it covers the whole top, sometimes it is branched into well-defined or vague strips, which occasionally are very narrow.

Island: the opaque part of the top surface surrounded by the window.

Pellucid dots: miniature windows of at most 1 mm. diameter, mostly greenish or bluish in colour and scattered over the top; these dots are not considered here as belonging to the window.

Blue dots: miniature windows situated under the epidermis; they are often inconspicuous, never clear-cut and not to be confused with the pellucid dots, which belong to the epidermis.

Flowers: where it is mentioned that the flowers are (for example) 5-merous, there are 5 sepals, 5 styles and 5 fruit-valves.

Seeds: the size of the seeds is an important characteristic and though it may be very difficult for amateurs to determine it, the authors still decided to use this characteristic; they recognise 5 groups:—

group 1: 1500-2000 seeds to 1 cubic cm.

group 2: 4000-5000 seeds to 1 cubic cm.

group 3: $\pm$ 7000 seeds to 1 cubic cm.

group 4: $\pm$ 10,000 seeds to 1 cubic cm.

group 5: $\pm$ 15,000 seeds to 1 cubic cm.

Numbers in parenthesis following the species designation refer to color plates.

THE KEY:

1. flowers white; top of the young seedlings (3-7) weeks old $\pm$ convex; fissure rather long, separating the two leaves for more than a half 2
flowers yellow or straw-coloured (to light orange) ; top of the young seedlings rather flat, the fissure localised in the form of a rather short aperture in the centre of the top 16
2. fissure wide, in adults mostly deeper than 10 mm.; bodies greyishgreen,

- sometimes suffused with pink, or entirely purplish red: flowers 5— or 6—merous 3
- fissure not wide, hardly ever deeper than 10 mm; bodies not greyish-green or purplish-red; flowers nearly always 5-merous 4
3. bodies greyish-green to greenish, sometimes suffused with amethyst-colour; window with grey islands; flowers mostly 6-merous; seed-group 5—Little Namaland (4a) (Mes. m. N. E. Br., *L. umdausensis* L.Bol., *L. framesii* L.Bol., *L. helmuthii* var. *albiflora* Jac.)
- marmorata* (N.E.Br.) N.E.Br. (191-195)
- L. elisae* de Boer, differs from the preceding: window reduced to narrow strips; Little Namaland (4a) . (72, 73)
- differs from *L. marmorata*: window without or only with some islands, or slightly maculate along the margin; flowers mostly 5-merous; seed group 4—Great Namaland (2a) (*Mes. o.* Marl.)
- optica* (Marl.) N.E.Br. (209)
- r. rubra* (Tischer) Rowley (*Mes. o.* var. *r.* Tischer), bodies entirely purplish-red. (210, 211)
4. top with brown or reddish-brown lines (sometimes only within the ultimate branches of the window or only along the inner margin) 5
- top without brown lines 11
5. top flat with grey margins; window large with some islands, or consisting of broad strips; outer margin with shell-like notches and with dark- brown spots or lines in the projections between these notches; seed group 5—Kenhardt-division (4b)
- fulleri* N.E.Br. (74-81)
- var. *fulleri*, window green, purplish or reddish-brown.
- var. *brunnea* de Boer, window brownish, with short ultimate projections; islands smaller; notches broader and shorter, dark brown lines within the projections less distinct. (82-85)
- var. *ochracea* de Boer, differs from the preceding variety by the deep ochre-coloured windows and the light ochre-coloured islands and sides. (86-88)
- var. *chrysocephala* (Nel) de Boer (*L.c.* Nel), window reduced to narrow strips, hence the islands larger; colours as in the type-variety; not in cultivation. (89)
- outer margin of the window not as in *L. fulleri* 6
6. top slightly convex, strikingly light coloured; window often visible; network coloured or not; inner margin nearly always with a brown, sometimes fragmentary line; seed-group 5—Warmbad (3b) (*Mes. j.* Dint. & Schw.)
- julii* (Dint. & Schw.) N.E.Br. (133)
- var. *julii* (*L. julii* var. *pallida* Tischer, *L. lactea* Schick & Tischer), network only a little darker than the top.
- var. *reticulata* (Dint. & Schw.) N.E.Br. (*Mes. reticulata* Dint. &

- Schw.), top whitish, pinkish or bluish-pink, with a conspicuous yellowish-brown impressed network. (134–136)
 var. *littlewoodii* de Boer, differs from var. *julii* by the larger bodies and by the absence of the brown line along the fissure; hence rather similar to *L. karasmontana* var. *opalina*. (137)
 top not so strikingly light coloured and never with a brown line along the inner margin 7
7. top with a mostly branched window 8
 window absent 9
8. top slightly convex; window not surrounded by a whitish border; brownish markings mostly not very distinct *bella* N.E.Br. (see 14a)
 top flat; window surrounded by a conspicuous whitish border
salicola var. *reticulata* de Boer (see 15a)
9. top flat, ochre-yellow to purplish-brown; grooves and markings continuously running from the inner to the outer margin forming a rather fine network; brown lines not broader at the junctions; sometimes the grooves are rather broad and confluent, forming windows; seed-group 5—Prieska (6) *hallii* de Boer (110–117)
 top slightly but conspicuously convex; grooves mostly not running from the inner to the outer margin, hence the top seldom distinctly reticulate; brown lines often broader at the junctions 10
10. markings rather wide, not or indistinctly grey-edged; ultimate projections single or bifurcate; seed-group 5—Karas-mountains (3b) (*Mes. K.* Dint. & Schw.) *karasmontana* (Dint. & Schw.) N.E.Br. (140–146)
 var. *karasmontana*, top light greyish-yellow to light reddish-brown, sometimes lightly brownish-suffused.
 var. *summitatum* (Dint.) de Boer & Boom (*M.s.* Dint. *L.s.* Dint.), top reddish-brown; network less impressed and without brown lines; perhaps *L. gulielmi* L.Bol. belongs here. (147–150)
 var. *mickbergensis* (Dint.) de Boer & Boom (*L.m.* Dint., *L. lateritia* Dint., *L. jacobseniana* Schw.), top yellowish-red; network finer, more distinct, with darker, sometimes stellate-branched lines. (154–160)
 var. *opalina* (Dint.) de Boer & Boom (*L.o.* Dint.), top opaque to light amethyst-coloured, with vague markings. (151–153)
 markings narrow, distantly grey-edged; ultimate projections mostly trifurcate (as chickenlegs); seed-group 3—Great Namaland (2c) (*L. eberlanzii* Hort., not Dint. & Schw.)
erniana Loesch & Tischer (66–69)
 var. *erniana* top brownish-yellow; network fine, dark brown (resembles *L. karasmontana* var. *mickbergensis*).
 var. *witputzensis* de Boer, top light amethyst-coloured with light blue markings, without or with only a few brown lines (resembles *L. karasmontana* var. *opalina*)

11. (4). top slightly convex, bluish-grey; window dark brownish-grey, mostly with brown to chocolate-coloured islands; base of the lobes in the fissure with a conspicuous pink blister; flowers 6-merous, very late flowering (from the end of October); seed-group 5—

deboeri Schw. (48–51)

base of the lobes without a conspicuous pink blister; flowers mostly 5-merous, already finished in October; seed-group 5 or 3

12. markings vague or absent 12
markings conspicuous, often reticulate 14

13. top light yellowish-pinkish, with slightly darker, vague markings and hardly ever brown points or short lines along the inner margin (to examine several specimens)

julii var. *littlewoodii* de Boer (see 6a)

top opaque to light amethyst-coloured with vague “karasmontana”—markings, always without a brown line

karasmontana var. *opalina* (Dint.) de Boer & Boom (see 10a)

top as in the preceding variety, but markings finer, often bluish, the ultimate branchlets bifurcate

erniana var. *witputzensis* de Boer (see 10b)

14. top slightly convex; window often impressed, $\pm$ transparent, with dark coloured strips of which one (often fragmentary present) along the inner margin and antler-shaped ending in the outer margin; sometimes some brownish-red lines are present; seed group 3—Great Namaland (2c) and Karas-mountains (3a) (*Mes. b.* (N.E.Br.) Dint.)

bella N.E.Br. (20–25)

var. *bella*, strips of the window dark coloured; islands light yellow, pinkish-yellow or light brownish-yellow.

var. *lericheana* (Dint. & Schw.) de Boer & Boom (*Mes. I.* Dint. & Schw. *L.I.* (Dint. & Schw.) Jac.), differing from the preceding variety by the darker strips and the darker brownish islands. (26–29)

var. *eberlanzii* (Dint. & Schw.) de Boer & Boom (*Mes.e.* Dint. & Schw., *L.e.* (Dint. & Schw.) N.E.Br.), window less impressed, less transparent, more branched on the outer margin; islands grey to bluish-grey, sometimes brown or purplish; often these characters not simultaneously present; *L. eberlanzii* in our cultures is sometimes *L. erniana* (see 10b)

window large, often with islands 15

15. main colour of the bodies lead-grey; window olive-green mostly with light grey to light greyish-pink coloured islands, mostly with a conspicuous whitish border; flowers 5-merous; seed-group 3—S. Orange River Col. (6b)

salicola L.Bol. (240–246)

var. *salicola*, top slightly convex, without other markings.

var. *reticulata* de Boer, window flat with a rather dense and red-

dish-brown network, which is sometimes indistinct at times somewhat similar to *L. hallii*, although the latter has a grooved top (247–251) differing from the preceding species; main colour of the bodies greenish-yellow to nut-coloured; window more olive-brown often with greyish to nutcoloured islands; flowers 6-merous; Calvinia (5a)

villetii L.Bol. (300, 301)

16. (1). top with blue or greenish pellucid dots 17
top without pellucid dots 23

17. pellucid dots large, rather numerous and regularly scattered, seed group 3 18

pellucid dots not so large and not regularly scattered 19

18. top convex, evenly coloured between the large, bluish green dots and the occasional window; flowers 5-merous; Cape Prov. (5h) (*Mes. I.* N.E.Br.) *localis* (N.E.Br.) Schw. (179–182)

var. *localis*, bodies rather small; top fawn, marked only with pellucid dots, window nearly always absent.

var. *peersii* (L.Bol) de Boer & Boom (L.p. L.Bol.) bodies somewhat larger in comparison with the type-variety; top bluish-purple; window mostly absent, but sometimes rather distinct. (183)

var. *terricolor* (N.E.Br.) de Boer & Boom (*L.t.* N.E.Br.), bodies as large as in the preceding variety; top greyish- to yellowish-green; window large or rather small, greenish. (184, 185)

top flat or slightly convex, dirty blue to reddish brown, with rather numerous large, dark bluish-green, slightly raised pellucid dots intermixed with tiny red lines; window absent—Karas-mountains (3a) *Mes.f.* N.E.Br., *M. lydiae* L.Bol.)

fulviceps (N .E. Br.) N.E.Br. (93–96)

19. pellucid dots arranged along dendritic markings, which are often red or brown and mostly with blue edges; sometimes the red lines are present only and the pellucid dots only visible by a lens; flowers 6-merous, mostly in July (except in *L. weneri*) 20

pellucid dots not arranged as in the preceding or along narrow window-strips (*L. lesliei*); flowers 5- or 6-merous, from August to October 21

20. bodies rather small, ½ to 2/3 of the size of the next species; top convex, greyish to brown, with 2 (-3) dendritically branched lines; there are specimens nearly without markings (similar to *L. ruschiorum*) and specimens with very narrow lines (as in *L. gracilidelineata*)—N. Damaraland (I)

weneri Schw. & Jac. (302–304)

bodies rather larger; top flat or slightly convex, greyish to brown, with at least 4 dendritically branched lines (these markings sometimes indistinct)—N. Damaraland (I) (*Mes. p.* Berger)

pseudotruncatella (Berger)

N.E.Br. (214–218)

1. edges of the markings usually darker than the rest of the top.

- var. *pseudotruncatella* (*L. alpina* Dint.), top brownish-grey, dendritic markings brown or brown-red, with dark bluish or grey edges. (219–221)
- var. *pulmonuncula* (Dint. & Jac.) Jac. (*L.p.* Dint & Jac.), differs from the preceding variety by its more bluish-grey appearance; top more even brownish grey in the centre suffused with blue-green; markings and pellucid dots sometimes indistinct. (222–224)
- var. *elisabethae* (Dint.) de Boer & Boom (*L.e.* Dint.), top greyish-blue, mostly coppery suffused; pellucid dots not always distinctly dendritically arranged. (225, 226)
- var. *edithae* (N.E.Br.) de Boer & Boom (*L.e.* N.E.Br.), top light bluish-grey; lines and dots rather distinct; dark-bluish edges sometimes indistinct, (227–229)
- var. *brandbergensis* de Boer, top evenly yellow-brown with very prominent dark red-brown dendritic markings, rather vague bluish edges and very vague bluish dots. (234)
2. edges of markings not or scarcely darker than rest of the top.
- var. *mundtii* (Tischer) Jac. (*L.m.* Tischer), bodies rather flat; top rather even yellowish brown, with distinct dendritic markings. 235 (230, 231)
- var. *dendritica* (Nel) de Boer & Boom (*L.d.* Nel, *L. farinosa* Dint.), top greyish-brown, with prominent brown dendritic markings; pellucid dots often only visible with a lens (or nearly absent); sometimes the top is greyish with very short, brown lines, which although not connected, are distinctly dendritically arranged (the latter is in cultivation as *L. farinosa*, the difference being too little to maintain it as a separate taxon)
- var. *volkii* (Schw.) de Boer & Boom (*L.v.* Schw.), bodies greyish-white to almost white; markings indistinct. (232, 233)
21. top mostly flat; fissure very narrow, caused by the closely set lobes; window (at least in typical specimens) consisting of irregular confluent areas; pellucid dots mostly numerous, but never dominating, sometimes dendritically arranged along very narrow window-strips; flowers 5-merous; seed-group I—Transvaal, O. River Col. (7) (*Mes.I.* N.E.Br.)
- lesliei* (N.E.Br.) N.E.Br. (161–164)
- var. *lesliei*, bodies dull ferrugineous to greenish; window green; islands and margins ferrugineous-yellow.
- var. *venteri* (Nel) de Boer & Boom (*L.v.* Nel), main colour of the bodies grey; window greenish- to dark grey, mostly divided into narrow dendritic strips; islands and margins greyish-yellow. (166, 167)
- var. *maraisii* de Boer, sides grey in various shades; window very variable, greenish-brown to brownish-red, strongly branched or covering the whole top; islands and margins ochre-coloured. (170–172)
- var. *luteoviridis* de Boer, main colour of the bodies green; windows

light green; islands yellowish-green. (165)

var. *rubrobrunnea* de Boer, bodies reddish, sometimes reddish-brown, except the window, which is greenish-brown, less branched caused by the less numerous islands. (173–176)

var. *minor* de Boer, bodies twice as small (top $\pm$ 1 cm. diam.) and cinnamomeous except the window. (168, 169)

top mostly $\pm$ convex; fissure not very narrow; window not branched as in the preceding; flowers 6-merous; seed-group 3

22

22. top convex, greyish-yellow, sometimes tinged with green or greenish-brown; window scarcely visible or composed of an irregular network of vague, rather narrow bands; pellucid dots rather small, sometimes inconspicuous; bodies make a clear grey impression—Great Namaland (2a)

franciscii (Dint. & Schw.) N.E.Br. (90–92)

top $\pm$ convex, window always distinct and branched, with antler-like branches in the outer margin; pellucid dots conspicuous or absent; general colour of the bodies dirty brownish- to reddish-grey—Great Namaland (2b)

gesinae de Boer (97–99)

var. *gesinae*, window dirty green, without vague blue dots, antler-like branches rather few; pellucid dots rather numerous; of the same colour as the window or more bluish.

var. *annae* (de Boer) de Boer & Boom (*L.a.* de Boer) (I), window dark pink to dirty brown, with vague bluish dots; antler-like branches numerous; pellucid dots absent or few. (100)

23. (16). top strikingly flat and reddish-brown; fissure very narrow: Bechuanaland (7a)

aucampiae L.Bol. (1–11)

var. *aucampiae*, window dark olive-green to reddish-brown, strongly branched, with numerous antler-like branches in the outer margin and without spots or dots.

var. *koelemanii* (de Boer) de Boer (*L.k.* de Boer), window absent; pellucid dots numerous, greenish, usually connected by small, $\pm$ impressed red lines. (12–15)

bodies not so reddish-brown coloured 24

24. top with red or brown dots or lines (sometimes only a few are present); flowers 5-, sometimes 6-7-merous 25

top never with red or brown dots or lines; flowers always 5-merous 40

25. top slightly convex, bluish-green to yellowish-brown, with small raised red (later grey) warts; flowers 5-merous, light brownish-yellow to orange; seed-group 5—Kenhardt-division (6a)

verruculosa Nel (287, 288)

var. *verruculosa*, window reduced to grooves giving a finely rugose

character; top bluish-grey, the fine, impressed network of the same colour, or a little darker.

var. *inae* (Nel) de Boer & Boom (*L.i.* Nel), top with a band-like branched window instead of grooves, bluish-grey to brownish.

(289–293)

raised red warts absent; flowers yellow 26

26. bodies rather small; window large, sometimes irregularly but seldom distinctly bandlike branched (in *L. dinteri*) 27

bodies larger than in the preceding; window absent or band-like branched 28

27. top flat or slightly convex; window brownish-green, sometimes with yellowish dots and always with 3–15 red dots or little lines, bordered irregularly with brownish-yellow; margin with dark bluish-green dots; seed group 5—Warmbad (3b)

dinteri Schw. (52, 53)

top flat; window light brownish- or yellowish-green, mostly with 1–3 dull red dots, less marked, usually with some bluish dots bordered by a sharp, yellowish band; the bluish-green dots are in the margin, present or not; seed group 4—Little Namaland (4a)

brevis L.Bol (38, 39)

28. top dark-coloured, fine papillose; islands reddish-brown; window greenish-grey, large, sometimes branched, with red, (sometimes greyish-green) lines and with numerous glossy pellucid points, which are especially distinct if they are seen against the light—Griqualand (4c)

glaudivae de Boer (105–109)

top without the glossy points mentioned above 29

29. top with a branched window; flowers 5-merous 30

top without a window or, if the window is vaguely present, it is never branched; flowers 5- or 6-7-merous 33

30. top slightly convex, smooth to the touch, buff-coloured; window branches dark grey, with red dots and red, sometimes bifurcated lines; colour of the window strongly contrasting against the islands and margin; seed-group 3—Little Namaland (4a)

dorotheae Nel (61–65)

top not so coloured as in *L. dorotheae* 31

31. strips of the window yellowish-brown with bullate, yellowish islands, brownish-red lines and blue points; outer margin with 6–10 bifurcations; plants make at some distance a. yellowish-redbrown impression; seed-group 3—Gordonia (4c)

bromfieldii L.Bol. (34–37)

markings finer; outer margin with 10 more bifurcations; show of the plants at some distance not so yellowish-brown 32

32. top slightly bullate, but smooth to the touch; window greenish-grey, distinctly transparent; islands yellowish-brown; red lines and dots pres-

ent (no blue dots); plants make at some distance a rather dark green-brown impression; seed-group 3—Gordonia (4c)

insularis L.Bol (127–132)

differing from the preceding: top not smooth to the touch, with a finer network; window less transparent; red lines absent or indistinctly in the centre of the window and only visible with a lens; plants make a grey-brown impression; seed-group 2—Hopetown

marginata Nel (186–190)

33. (29). top strongly convex, light coloured; markings absent or consisting of some dark lines or dots; flowers 6-7, seldom 5-merous; seed-group 5—Damaraland (I) (*Mes.r.* Dint. & Schw.)

ruschiorum (Dint. & Schw.) N.E.Br. (236,237)

var. *ruschiorum*, bodies grey, sometimes suffused with amethyst, top with some dark points or short lines: flowers 6-7 merous.

var. *lineata* (Nel) de Boer & Boom (*L.I.* Nel.), bodies whitish- to orange-yellow; top with some conspicuous dark, slightly impressed lines; flowers 6-7-merous. (238)

var. *nelii* (Schw.) de Boer & Boom (*L.n.* Schw., *L.r. ssp. stiepelmanii* Schw.), bodies smaller, rather variable in size, light grey to nearly white; top without markings or with some brown little spots or lines; flowers 5-merous. (239)

L. steineckiana Tischer, differs from *L. ruschiorum* by the shorter lobes and the top, which has some or more scattered greyish-green dots; flowers 7-merous (perhaps *L. pseudotruncatella* x *L. ruschiorum*). (252)

top less convex, mostly distinctly marked; flowers 5-6-merous 34

34. bodies yellowish to bluish light grey; top slightly convex wrinkly by very fine vermiform and chalky ridges (use a strong lens) ; markings absent or consisting of very vague, a little darker coloured (never reddish brown) lines; seed-group 2—Great Namaland (2b) (*Mes. v.* Dint. & Schw.)

vallis-mariae (Dint. & Schw.) N.E.Br. (298, 299)

top not wrinkly as in the preceding 35

35. bodies rather large, strikingly light grey, sometimes yellowish, often slightly suffused with amethyst; top flat or slightly convex; lines very narrow, dark brown, not impressed, sometimes reticulately arranged, sometimes individually running from the inner to the outer margin; a few pellucid dots sometimes present; flowers 6-merous, in August;—Damaraland (I)

gracilidelineata Dint. (101, 102)

var. *gracilidelineata*, top greyish-white, flat or slightly bullate; lines continuously running from the inner to the outer margin, forkedly branched.

var. *waldronae* de Boer, top light yellowish-grey, strongly bullate;

- lines very narrow, interrupted and strongly-branched.(103, 104)
top not coloured as in the preceding and lines not so narrow; flowers
5-merous 36
36. grooves distinct, in summer, forming a network with continuous brown
to reddish brown lines; blue dots mostly absent; seed group 2 37
grooves indistinct or only present in winter and after dry cultivation; top
with irregular markings consisting of interrupted brown or reddish-brown
lines; blue dots sometimes suffuse, usually present (in *L. mennellii* ab-
sent); seed-group 2 or 3 38
37. top rather flat, greyish-brown to brownish-red, without dots but with
an impressed network of narrow, reddish-brown grooves; and a reddish
brown line along the fissure; sides brown; there are also forms with
broader grooves, $\pm$ confluent, forming a window—Cape Prov. (6) (*Mes.*
t. Haw.), *L. aurantiaca* (L.Bol.)
turbiniformis (Haw.) : N.E.Br. (268–274)
top flat, greyish-yellow, sometimes tinged with blue, with some bluish-
green dots; network slightly impressed, consisting of darker grooves and
with brownish-red points or little lines; no line along the fissure; sides
lead-grey—Great Namaland (2b)
- christinae* de Boer (40–43)
38. top flat, slightly bullate between the grooves, dirty brownish-grey; lines
dark brown, interrupted, rather thick and slightly impressed, according
to some authors resembling hebrew script; blue points always absent—
Gordonia (4c)
- mennellii* L.Bol (199–201)
top flat or convex, not coloured and marked as in the preceding, never
bullate between the grooves 39
39. top flat, brownish to greenish-blue, bordered by a light yellow band;
grooves absent, markings only consisting of some scarcely visible,
brownish-red lines or spots; blue points absent; seed-group 3—Great
Namaland (2c)
- marthae* Loesch & Tischer (197, 198)
top slightly convex, mostly bordered by a yellowish or pinkish band, usu-
ally with grooves, markings distinct, consisting of reddish-brown, usually
interrupted lines; blue points present (sometimes only a few) seed-group
2—Great Namaland (2b)
- schwantesii* Dint. (253–256)
var. *schwantesii* (*L. kuibisensis* Dint. & Jac.), top smooth, dark-grey-
ish yellow-red, with a distinct blue tint in the centre, bordered by a
pink band; blue points few to rather numerous.
var. *kunjasensis* (Dint.) de Boer & Boom (*L.k.* Dint.), similar to pre-
ceding but more variable and grooves more pronounced; only to dis-
tinguish in summer and in comparison with the preceding. (257, 258)
var. *rugosa* (Dint.) de Boer & Boom (*L.r.* Dint.), top $\pm$ amethyst-
coloured, nearly without a pink border; grooves distinct, especially on

- young leaves; blue points rather numerous. (266)
 var. *triebneri* (L. Bol.) de Boer & Boom (*L.t.* L. Bol.), top grey to leather-brown, with a pinkish border; blue points distinct; a variety from Bethanie with smaller bodies and more variable in colour is erroneously in cultivation under the name *L. gulielmi*. (259, 260)
 var. *urikosensis* (Dint.) de Boer & Boom (*L.u.* Dint., *L. gulielmi* Nel, not L. Bol.), bodies light grey (as concrete), without a pink border. (261–263)
40. (24). bodies grey to pink; fissure shallow; window large, greyish-green, sometimes suffused with pink; islands nearly exclusively along the margin, those of the outer margin connected with the latter, those of the inner margin free or connected with a little line; seed-group 3—Brakfontein (5a)
otzeniana Nel (212, 213)
 islands not arranged as in the preceding 41
41. bodies greyish-green; top obliquely declining (one side higher); window large, light green, with light grey spots and many irregular lighter coloured islands; seed-group 5 (similar to *L. marmorata*, which has a horizontal top and a white flower)—Little Namaland (4a)
helmutii L.Bol. (118–121)
 top horizontal or declining to the fissure 42
42. bodies light grey to olive-green, sometimes tinged with pink; window smaller than the top, of the same colour but slightly darker, usually with a few islands; outer margin lighter coloured crenate; top of the whole body oval (seen from above) and with a narrow fissure; seed-group 5—Bushmanland (4b)
olivacea L.Bol. (205–208)
 window as large as the top which is not oval (seen from above) 43
43. window mostly branched, always with islands; flowers 5-6-merous 44
 window entire, without islands or if they are present, the window seldom branched; flowers 5-merous 45
44. bodies greyish-brown, sometimes suffused with pink; window large, greenish-blue, strikingly branched, with sharply edged, raised islands which make the top $\pm$ bullate; also specimens with a nearly smooth window with few islands occur (these are rather similar to *L. comp-tonii*, but this never has a greenish-blue window); seed-group 5—Calvinia (6a)
weberi Nel* (305, 306)
 differing from the preceding: bodies pink- to ochre-coloured; window dark pink to dirty brown; islands less raised; seed group 3
gesinae var. *annae* de Boer
 (see 22)
- *see also *L. marginata* Nel (32b); this has redbrown lines in the grooves which are indistinct or absent in some specimens.
45. bodies light bluish-grey (as in *Argyroderma*) with divergent lobes, which

are broader than high to as broad as high; top usually sickle-shaped, caused by the bent inner margin; window not distinct, sometimes with vague markings; seed group 5—Little Namaland (4a)

meyeri L. Bol. (202–204)

bodies not light bluish-grey, top not sickle-shaped (or a little); seed-group 2–4 46

46. bodies greyish-green to pinkish; sides (especially of the seedlings) suffused with purple; window green, smooth, without islands; specimens with pinkish shade resemble sometimes $\pm$ *L. comptonii*; seed-group 2—Calvinia (6a)

viridis Lueckh. (296, 297)

window with islands; sometimes only a few islands are present; seed-group 3 or 4 47

47. bodies greyish-green, sometimes very little suffused with purple 48
bodies purplish 49

48. lobes elongated; top flat $\pm$ semilunar (the inner margin bent), on average of unequal size; window with a variable number of whitish islands; seed-group 4—van Rhynsdorp (6a)

divergens L. Bol. (59, 60)

var. *divergens*, bodies entirely greyish-green; top semilunar.

var. *amethystina* de Boer, bodies amethyst-coloured. (56–58)

differing from *L. divergens*: lobes not or only a little elongated; top convex, semi-orbicular (the inner margin straight) on average of equal size; seed-group 3—Little Namaland (4a)

herrei L. Bol. (122, 123)

var. *herrei*, top somewhat convex, greyish-green, with indistinct islands. var. *hillii* (L. Bol.) comb. nova (*L.h* L. Bol.) I), as the preceding variety but mostly suffused with a little pink and with rather distinct islands (125–126)

var. *geyeri* (Nel) de Boer & Boom (L.g. Nel) top rather convex, yellowish grey-green, with distinct islands. (124)

In variability these 3 varieties overlap each other, so it may be difficult to determine one specimen.

49. bodies rather small, reddish, with short slightly convex lobes; window always with small islands; seed-group 4—Ceres (6a)

comptonii L. Bol. (44–47)

differing from the preceding: bodies large, reddish, with elongated rather fiat lobes; window without or with vague islands.

divergens var. *amethystina*
de Boer (see 48a)

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List of Plates

I

Lithops aucampiae L.Bol.

IA

Lithops aucampiae L.Bol.

IB

Lithops aucampiae var. koelemanii de Boer

Lithops aucampiae var. euniceae de Boer

II

Lithops bella N.E.Br.

IIA

Lithops bella var. lericheana (Dint. & Schwant.) de Boer & Boom

Lithops bella var. eberlanzii (Dint. & Schwant.) de Boer & Boom

III

Lithops bromfieldii L. Bol.

Lithops brevis L.Bol.

IV

Lithops christinae de Boer

Lithops comptonii L.Bol.

V

Lithops deboeri Schwant.

Lithops dinteri Schwant.

Lithops dinteri var. multipunctata de Boer

VI

Lithops divergens L.Bol.

VII

Lithops dorotheae Nel

VIII

Lithops erniana Loesch. & Tisch.

Lithops erniana var. *aiaisensis* de Boer

Lithops elisae de Boer

IX

Lithops fulleri N.E.Br.

IXA

Lithops fulleri var. *brunnea* de Boer

Lithops fulleri var. *ochracea* de Boer

Lithops fulleri var. *chrysocephala* (Nel) de Boer

X

Lithops franciscii (Dint. & Schwant.) N.E.Br.

Lithops fulviceps (N .E.Br.) N.E.Br.

XI

Lithops gesinae de Boer

Lithops gesinae var. *annae* de Boer & Boom

Lithops gracilidelineata Dint.

Lithops gracilidelineata var. *waldronae* de Boer

XII

Lithops glaudinae de Boer

XIII

Lithops hallii de Boer

XIV

Lithops helmutii L.Bol.

XV

Lithops herrei L.Bol.

Lithops herrei var. *geyeri* (Nel) de Boer & Boom

Lithops herrei var. *hillii* (L.Bol.) de Boer & Boom

XVI

Lithops insularis L.Bol.

XVII

Lithops julii (Dint. & Schwant.) N.E.Br.

Lithops julii var. *reticulata* (Dint. & Schwant.) N.E.Br.

Lithops julii var. *littlewoodii* de Boer

Lithops julii var. *rouxii* de Boer

XVIII

Lithops karasmontana (Dint. & Schwant.) N.E.Br.

XVIII A

Lithops karasmontana var. *summitatum* (Dint.) de Boer & Boom

Lithops karasmontana var. *opalina* (Dint.) de Boer & Boom

XVIII B

Lithops karasmontana var. *mickbergensis* (Dint.) de Boer & Boom

XIX

Lithops lesliei (N.E.Br.) N.E.Br.

Lithops lesliei var. *luteoviridis* de Boer

XIXA

Lithops lesliei var. *venteri* (Nel) de Boer & Boom

Lithops lesliei var. *minor* de Boer

Lithops lesliei var. *maraisii* de Boer

XIXB

Lithops lesliei var. *rubrobrunnea* de Boer

Lithops lesliei var. *hornii* de Boer

XX

Lithops localis (N.E.Br.) Schwant.

Lithops localis var. *peersii* (L.Bol.) de Boer & Boom

Lithops localis var. *terricolor* (N.E.Br.) de Boer & Boom

XXI

Lithops marginata Nel

XXII

Lithops marmorata (N.E.Br.) N.E.Br.

XXIII

Lithops marthae Loesch. & Tisch.

Lithops mennellii L.Bol.

Lithops meyeri L.Bol.

XXIV

Lithops olivacea L.Bol.

XXV

Lithops optica (marl.) N.E.Br.

Lithops optica forma *rubra* (Tisch.) Rowley

Lithops otzeniana Nel

XXVI

Lithops pseudotruncatella (Berger) N.E.Br.

XXVIA

Lithops pseudotruncatella var. *pulmonuncula* (Dint. & Jac.) Jac.

Lithops pseudotruncatella var. *elizabethae* (Dint.) de Boer & Boom

Lithops pseudotruncatella var. *edithae* (N.E.Br.) de Boer & Boom

XXVIB

Lithops pseudotruncatella var. *dendritica* (Nel) de Boer & Boom

Lithops pseudotruncatella var. *volkii* (Schwant.) de Boer & Boom

Lithops pseudotruncatella var. *brandbergensis* de Boer

Lithops pseudotruncatella var. *mundtii* (Tisch.) Tisch. Ex Jac.

XXVII

Lithops ruschiorum (Dint. & Schwant.) N.E.Br.

Lithops ruschiorum var. *lineata* (Nel) de Boer & Boom

Lithops ruschiorum var. *nelii* (Schwant.) de Boer & Boom

XXVIII

Lithops salicola L.Bol.

XXVIII A

Lithops salicola var. *reticulata* de Boer

Lithops steineckeana Tisch.

XXIX

Lithops schwantesii Dinter *Lithops schwantesii* var. *kunjasensis* (Dint.) de

Boer & Boom

Lithops schwantesii var. *triebneri* (L.Bol.) de Boer & Boom

XXIXA

Lithops schwantesii var. *urikosensis* (Dint.) de Boer & Boom

Lithops schwantesii var. *nutupsdriftensis* de Boer

Lithops schwantesii var. *rugosa* (Dint.) de Boer & Boom

XXX

Lithops turbiniformis (Haw.) N.E.Br.

XXXA

Lithops turbiniformis var. *lutea* de Boer

Lithops turbiniformis var. *brunneo-violacea* de Boer

XXXB

Lithops turbiniformis var. *subfenestrata* de Boer

XXXI

Lithops verruculosa Nel

Lithops verruculosa var. *inae* (Nel) de Boer & Boom

Lithops verruculosa var. *glabra* de Boer

XXXII

Lithops viridis Luckhoff

Lithops vallis-mariae (Dint. & Schwant.) N.E.Br.

XXXIII

Lithops villetii L.Bol.

Lithops wernerii Schwant. & Jacobs.

Lithops weberi Nel

XXXIV

Dinteranthus vanzylii (L.Bol.) Schwant.

Index of Species

This list is in conformity with the Analytical Key of Dr. de Boer. *See National Catcus & Succulent Journal* Great Britain vol. 19 No. 3, 4 1964 pages 34–37, 51–55. Names in italics are synonyms.

Photo Number

<i>Lithops alpina</i> Dtr. = <i>L. pseudotruncatella</i>	
<i>Lithops annae</i> de Boer = <i>L. gesinae</i> var. <i>annae</i>	
<i>Lithops aucampiae</i> L. Bol.	1–11
<i>Lithops aucampiae</i> var. <i>koelemanii</i> de Boer	12–15
<i>Lithops aucampiae</i> var. <i>euniceae</i> de Boer	16–18
<i>Lithops aurantiaca</i> L. Bol. = <i>L. turbiniformis</i>	
<i>Lithops bella</i> (Dtr.) N.E.Br.	20–25
<i>Lithops bella</i> var. <i>eberlanzii</i> (Dint. & Schwant.) de Boer & Boom	30–33
<i>Lithops bella</i> var. <i>lericheana</i> (Dint. & Schwant.) de Boer & Boom	26–29
<i>Lithops brevis</i> L. Bol.	38, 39
<i>Lithops bromfieldii</i> L. Bol.	34–37
<i>Lithops Christinae</i> de Boer	40–43
<i>Lithops chrysocephala</i> Nel = <i>L. fulleri</i> var. <i>chrysocephala</i>	
<i>Lithops commoda</i> Dtr. = <i>L. karasmontana</i>	
<i>Lithops comptonii</i> L. Bol.	44–47
<i>Lithops dabneri</i> L. Bol. = <i>L. marginata</i>	
<i>Lithops damarana</i> N.E.Br. = <i>L. karasmontana</i>	
<i>Lithops deboeri</i> Schwant.	48–51
<i>Lithops dendritica</i> Nel. = <i>L. pseudotruncatella</i> var. <i>dendritica</i>	
<i>Lithops dinteri</i> Schwant.	52, 53

<i>Lithops dinteri</i> var. <i>multipunctata</i> de Boer	54, 55
<i>Lithops diutina</i> L. Bol. = <i>L. marmorata</i>	
<i>Lithops divergens</i> L. Bol.	59, 60
<i>Lithops divergens</i> var. <i>amethystina</i> de Boer	56–58
<i>Lithops dorotheae</i> Nel	61–65
<i>Lithops eberlanzii</i> (Dint. & Schwant.) N.E.Br. = <i>L. bella</i> var. <i>eberlanzii</i>	
<i>Lithops edithae</i> N.E.Br. = <i>pseudotruncatella</i> var. <i>edithae</i>	
<i>Lithops eksteeniae</i> L.Bol. = <i>L. dorotheae</i>	
<i>Lithops elevata</i> L. Bol. = <i>L. herrei</i>	
<i>Lithops elizabethae</i> Dint. = <i>L. pseudotruncatella</i> var. <i>elizabethae</i>	
<i>Lithops elisae</i> de Boer	72, 73
<i>Lithops erniana</i> Loesch. & Tisch.	66–69
<i>Lithops erniana</i> var. <i>aiaisensis</i> de Boer	70, 71
<i>Lithops erniana</i> var. <i>witputzensis</i> de Boer	
<i>Lithops farinosa</i> Dint. = <i>L. pseudotruncatella</i> var. <i>dendritica</i>	
<i>Lithops fossulifera</i> Tisch. = <i>nomen nudum</i>	
<i>Lithops framesii</i> L. Bol. = <i>L. marmorata</i>	
<i>Lithops franciscii</i> (Dint. & Schwant.) N.E.Br.	90–92
<i>Lithops friederichiae</i> N.E.Br. = <i>Ophthalmophyllum friederichiae</i>	
<i>Lithops fulleri</i> N.E.Br.	74–81
<i>Lithops fulleri</i> var. <i>brunnea</i> de Boer	82–85
<i>Lithops fulleri</i> var. <i>ochracea</i> de Boer	86–88
<i>Lithops fulleri</i> var. <i>chrysocephala</i> (Nel) de Boer	89
<i>Lithops fulleri</i> var. <i>tapscottii</i> L. Bol. <i>L. fulleri</i>	
<i>Lithops fulviceps</i> N.E.Br.	93–96
<i>Lithops gesinae</i> de Boer	97–99
<i>Lithops gesinae</i> var. <i>annae</i> (de Boer) de Boer Sc Boom	100
<i>Lithops geyeri</i> Nel. <i>L. herrei</i> var. <i>geyeri</i>	
<i>Lithops glaudinae</i> de Boer	105–109
<i>Lithops gracilidelineata</i> Dinter	101, 102
<i>Lithops gracilidelineata</i> var. <i>waldroneae</i> de Boer	103, 104
<i>Lithops gulielmi</i> L. Bol. = <i>L. schwantesii</i> var. <i>triebneri</i>	
<i>Lithops gulielmi</i> Nel = <i>L. schwantesii</i> var. <i>urikosensis</i>	
<i>Lithops halenbergensis</i> Tisch. = <i>L. bella</i> var. <i>eberlanzii</i>	
<i>Lithops hallii</i> de Boer	110–117
<i>Lithops helmutii</i> L. Bol.	118–121
<i>Lithops helmutii</i> var. <i>albiflora</i> Jac. = <i>L. marmorata</i>	
<i>Lithops Herrei</i> L. Bol.	122, 123
<i>Lithops herrei</i> var. <i>geyeri</i> (Nel) de Boer Sc Boom	124
<i>Lithops herrei</i> var. <i>hillii</i> (L. Bol.) de Boer & Boom	125–126
<i>Lithops herrei</i> var. <i>plena</i> (L. Bol.) <i>nomen nudum</i> = <i>L. Herrei</i>	
<i>Lithops hillii</i> L. Bol. = <i>L. herrei</i> var. <i>hillii</i>	

- Lithops hookeri* (Berger) Schwant. *L. localis* var. *peersii*
Lithops inae Nel = *L. verruculosa* var. *inae*
Lithops inornata Dinter = *L. marthae*
Lithops insularis L. Bol. 127–132
Lithops jacobseniana Schwant. = *L. karasmontana* var. *mickbergensis*
Lithops julii (Dint. & Schwant.) N.E.Br. 133
Lithops julii var. *pallida* Tisch. = *L. julii*
Lithops julii var. *reticulata* (Dint. & Schwant.) N.E.Br. 134–136
Lithops julii var. *typica* (Tisch.) ex de Boer = *L. julii* var. *reticulata*
Lithops julii var. *littlewoodii* de Boer 137
Lithops julii var. *rouxii* de Boer 138, 139
Lithops karasmontana (Dint. & Schwant.) N.E.Br. 140–146
Lithops karasmontana var. *mickbergensis* (Dint.) de Boer & Boom 154–160
Lithops karasmontana var. *opalina* (Dint.) de Boer & Boom 151–153
Lithops karasmontana var. *summitatum* (Dint.) de Boer & Boom 147–150
Lithops koelemanii de Boer = *L. aucampiae* var. *koelemanii*
Lithops kuibisensis Dint. Ex. Jacob. = *L. schwantesii*
Lithops kunjasensis Dint. = *L. schwantesii* var. *kunjasensis*
Lithops lactea Schick. Sc Tisch. = *L. julii*
Lithops lateritia Dint. = *karasmontana* var. *mickbergensis*
Lithops lericheana Dint. & Schwant. = *L. bella* var. *lericheana*
Lithops lesliei N.E.Br. 161–164
Lithops lesliei var. *venteri* (Net) de Boer & Boom 166, 167
Lithops lesliei var. *maraisii* de Boer 170–172
Lithops lesliei var. *luteoviridis* de Boer 165
Lithops lesliei var. *rubrobrunnea* de Boer 173–176
Lithops lesliei var. *hornii* de Boer 177, 178
Lithops lesliei var. *minor* de Boer 168, 169
Lithops lineata Nel. = *L. ruschiorum* var. *lineata*
Lithops localis (N.E.Br.) Schwant. 179–182
Lithops localis var. *terricolor* (N.E.Br.) de Boer & Boom 184, 185
Lithops localis var. *peersii* (L. Bol.) de Boer & Boom 183
Lithops loganae L. Bolus = *L. aucampiae*
Lithops lydiae Jacobs. = *L. fulviceps*
Lithops marlothii N.E.Br. *Conophytum pellucidum* Schwant.
Lithops marginata Nel 186–190
Lithops marmorata N.E.Br. 191–195
Lithops marthae Loesch. et Tisch. 197, 198
Lithops maughanii N.E.Br. = *L. fulleri*
Lithops mennellii L. Bol. 199–201
Lithops meyeri L. Bol. 202–204
Lithops mickbergensis Dint. = *L. karasmontana* var. *mickbergensis*

- Lithops mundtii* Tisch. = *L. pseudotruncatella* var. *mundtii*
Lithops nelii Schwant. = *L. ruschiorum* var. *nelii*
Lithops olivacea L. Bol. 205–208
Lithops opalina Dint. = *L. karasmontana* var. *opalina*
Lithops optica (Marl.) N.E.Br. 209
Lithops optica var. *minor* Jacob. = *L. optica*
Lithops optica forma *rubra* Tisch. 210, 211
Lithops otzeniana Nel 212, 213
Lithops orpenii L. Bol. = *L. lesliei*
Lithops peersii L. Bol. = *L. localis* var. *peersii*
Lithops pillansii L. Bol. = *L. ruschiorum*
Lithops pseudotruncatella (Bgr.) N.E.Br. 214–218
Lithops pseudotruncatella var. *pulmonuncula* (Dint. & Jac.) Jac. 222–224
Lithops pseudotruncatella var. *elizabethae* (Dint.) de Boer & Boom 225–226
Lithops pseudotruncatella var. *edithae* (N.E.Br.) de Boer & Boom 227–229
Lithops pseudotruncatella var. *dendritica* (Nel) de Boer & Boom 230, 231
Lithops pseudotruncatella var. *mundtii* (Tisch.) de Boer & Boom 235
Lithops pseudotruncatella var. *brandbergensis* de Boer 234
Lithops pseudotruncatella var. *volkii* (Schwant.) de Boer & Boom 232, 233
Lithops pseudotruncatella var. *groendrayensis* Jacob. = *L. vallis*
mariae var. *groendrayensis*
Lithops pulmonuncula Dint. = *L. pseudotruncatella* var. *pulmonuncula*
Lithops rubra N.E.Br. = *L. optica* forma *rubra*
Lithops rugosa Dint. = *L. schwantesii* var. *rugosa*
Lithops ruschiana N.E.Br. = *L. ruschiorum*
Lithops ruschiorum (Dint. & Schwant.) N.E.Br. 236, 237
Lithops ruschiorum var. *lineata* (Nel) de Boer & Boom 238
Lithops ruschiorum ssp. *stiepelmanniana* Schwant. = *L. ruschiorum* var. *nelii*
Lithops salicola L. Bol. 240–246
Lithops salicola var. *reticulata* de Boer 247–251
Lithops schickiana = nomen nudum
Lithops schwantesii Dinter 253–256
Lithops schwantesii var. *kunjasensis* (Dint.) de Boer & Boom 257, 258
Lithops schwantesii var. *rugosa* (Dint.) de Boer & Boom 266
Lithops schwantesii var. *triebneri* (L. Bol.) de Boer & Boom 259, 260
Lithops schwantesii var. *urikosensis* (Dint.) de Boer & Boom 261–263
Lithops schwantesii var. *nutupsdriftensis* de Boer
Lithops schwantesii var. *gebseri* de Boer 267
Lithops summitatum Dint. = *L. karasmontana* var. *summitatum*
Lithops steineckiana Tisch. 252 *Lithops streyi* Schwant. = *U. gracilidelineata*

<i>Lithops terricolor</i> N.E.Br. = <i>L. localis</i> var. <i>terricolor</i>	
<i>Lithops translucens</i> L. Bol. = <i>L. herrei</i>	
<i>Lithops triebneri</i> L. Bol. = <i>L. schwantesii</i> var. <i>triebneri</i>	
<i>Lithops turbiniformis</i> (Haw.) N.E.Br.	268–274
<i>Lithops turbiniformis</i> var. <i>lutea</i> de Boer	275–279
<i>Lithops turbiniformis</i> var. <i>Brunneo-violacea</i> de Boer	280, 281
<i>Lithops turbiniformis</i> var. <i>subfenestrata</i> de Boer	282–286
<i>Lithops umdausensis</i> L. Bol. = <i>L. marmorata</i>	
<i>Lithops urikosensis</i> Dint. = <i>L. schwantesii</i> var. <i>urikosensis</i>	
<i>Lithops ursulae</i> nomen nudum = <i>L. jacobseniana</i>	
<i>Lithops vallis-mariae</i> (Dint. & Schwant.) N.E.Br.	298, 299
<i>Lithops vallis-mariae</i> var. <i>groendrayensis</i> (Jacobs.) de Boer	
<i>Lithops vanZyltii</i> L. Bol. = <i>Dinteranthus vanzylii</i>	
<i>Lithops venterii</i> Nel <i>L. lesliei</i> var. <i>venterii</i>	
<i>Lithops verruculosa</i> Nel	287, 288
<i>Lithops verruculosa</i> var. <i>inae</i> (Nel) de Boer & Boom	289–293
<i>Lithops verruculosa</i> var. <i>glabra</i> de Boer	294, 295
<i>Lithops villetii</i> L. Bol.	300, 301
<i>Lithops viridis</i> Luckhoff	296, 297
<i>Lithops volkii</i> Schwant. = <i>L. pseudotruncatella</i> var. <i>volkii</i>	
<i>Lithops weberi</i> Nel	305, 306
<i>Lithops wernerii</i> Schwant. & Jacobs.	302–304

Plates

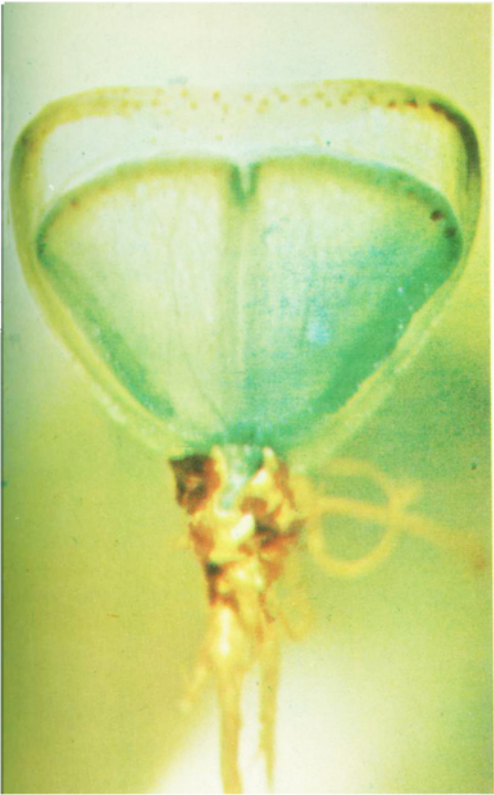


Fig. I

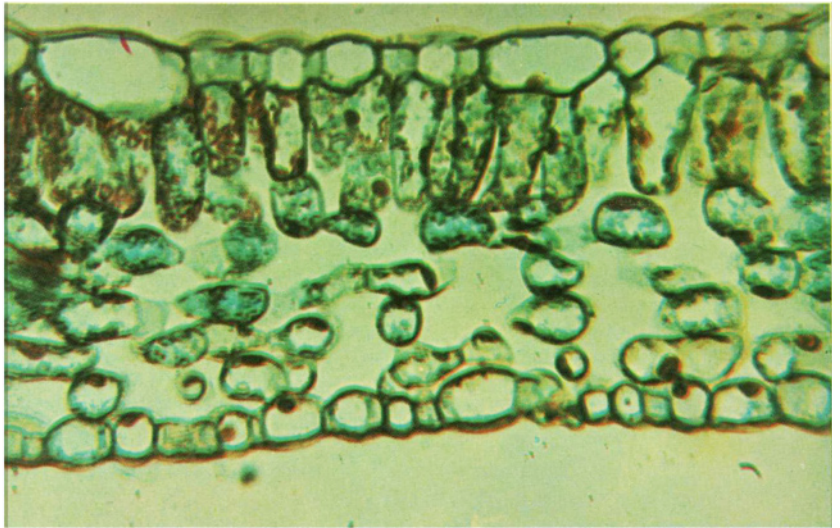


Fig. II

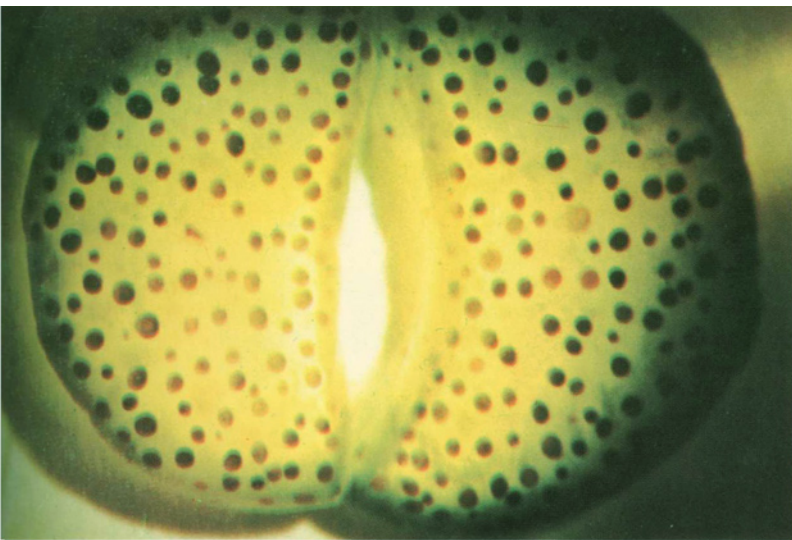


Fig. III



Fig. IV



Fig. V



Fig. VI

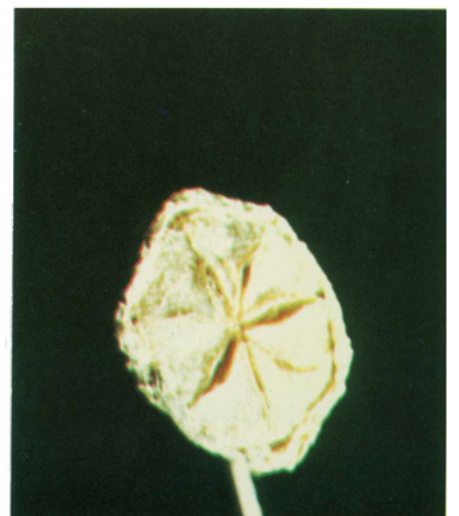
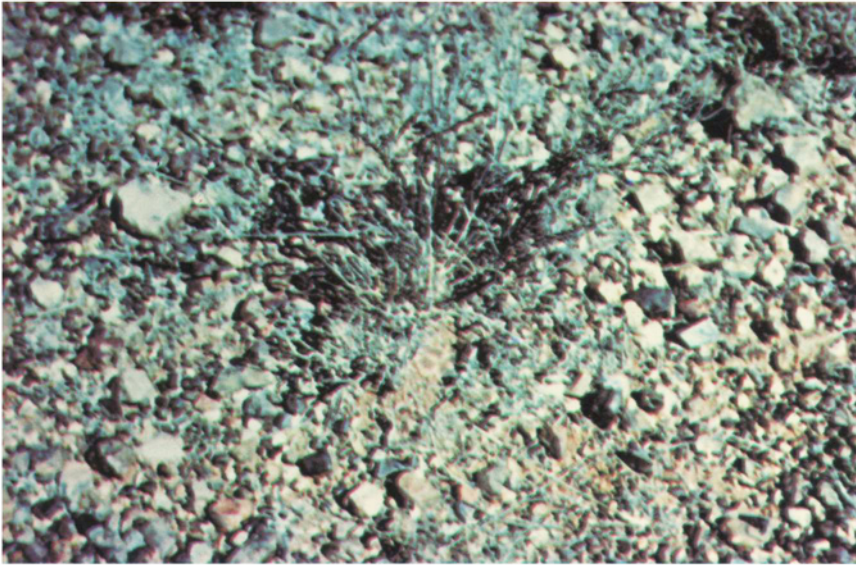


Fig. VII

These figures illustrates the structure and growth cycle of the lithops. See Chapter 1, page 15.



1



2



3

PLATE I

Litliops aucampiae (L.Bol.) 1931 (1-11)

Cape Province: Griqualand West; Griekwastad; Postmasburg; Danielskuil; Kuruman; between Kuruman and Vryburg. (See Analytical Key Map-7a)

A large and much varied species named after a Miss Aucamp of Postmasburg.

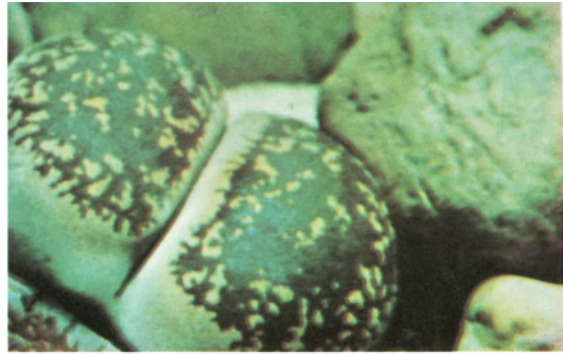
The red colorations of the dendritic markings on the outer margins is a common characteristic of this species.

Flowers yellow.

Habitat Photo: D. T. Cole

Coll: D. T. Cole

4, 5



6,7



8, 9



10, 11



PLATE IA

Lithops aucampiae L.Bol. (4–11)

This species shows great variability in both color and markings.

12



13



14



15

PLATE IB

Lithops aucampiae var. *koelemanii* de Boer (12–15)

Cape Province: Between Olifantshoek and Lohatlha. (See Analytical Key Map–7 a)

Coll: A. Koeleman of Pretoria, 1959. (*Succulenta*, 1960, pg. 28)

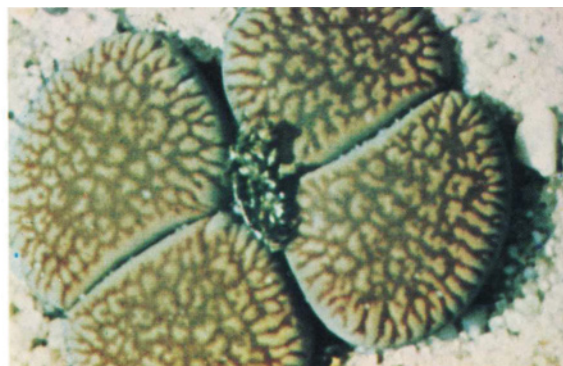
A red type with small deep markings that seldom coalesce to form windows as is the case with *L. aucampiae*.

Habitat Photo: D. T. Cole

16



18



18

Lithops aucampiae var. *euniceae* de Boer (16–18) (19 omitted)

Cape Province: 15 miles north of Hopetown. (See Analytical Key Map–6b)

Coll: Mr. A. H. Horn (Petrusville). Sept. 1963. (*Succulenta*, 1966, p. 54.)

Named after Mrs. Eunice E. Burmeister of Petrusville.

Green variety: D. T. Cole

Coll: H. W. de Boer



20



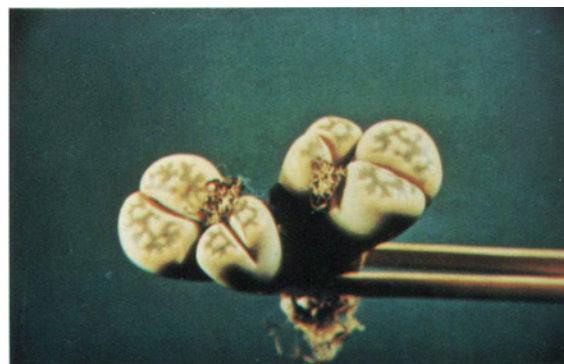
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25

PLATE II
Lithops bella N.E.Br. (20-25)

South West Africa: Great Namaland, Granite mountains near Aus-Gubub,
Gr. Karas mountains, Garub; Witputz. (See Analytical Key Map 2 c-3 a)

Discovered by Mr. E. C. Phillips, 1922.

Flowers white.



26



27



28



29



30



31

PLATE IIA

Lithops bella var. *lericheana* (Dint. & Schwant.) de Boer & Boom (26–29)

Considered by Jacobson (*A Handbook of Succulent Plants*, vol. 3, page 1237) to be a separate species mainly because of its intensely scented flower (like *Heliotrope*).

Found in 1924 by Professor Dinter and named after Herr Leriche, a farmer. Professor Nel does not recognize this plant as a separate species, however Professor Schwantes lists the name. (*Flowering Stones*, 1957, page 23). Dr. de Boer has reduced the name to varietal status. (See *Succulenta*, 1961, page 39.)

Lithops bella var. *eberlanzii* (Dint. & Schwant.) de Boer & Boom (30–33)

South West Africa: Great Namaland, Kavisberge, Rote Kuppe, Halenberg. (See Analytical Key Map–2 c)

Found by Herr Friedrich Eberlanz of Luderitz Bay in 1923 and named after him.

Reduced to varietal status by Dr. de Boer (see *Succulenta*, 1961, page 38)



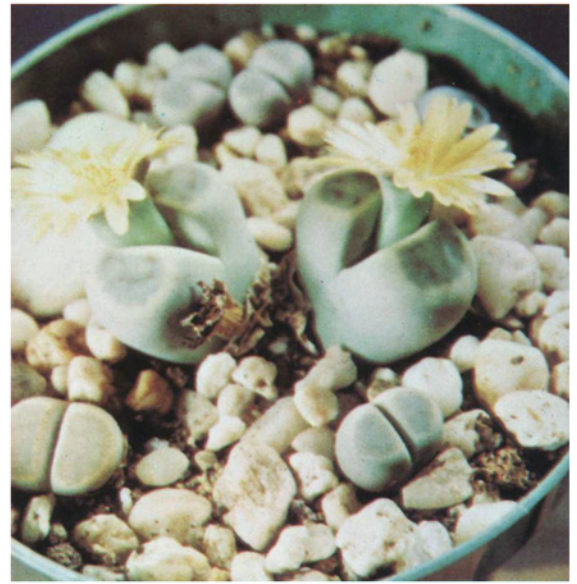
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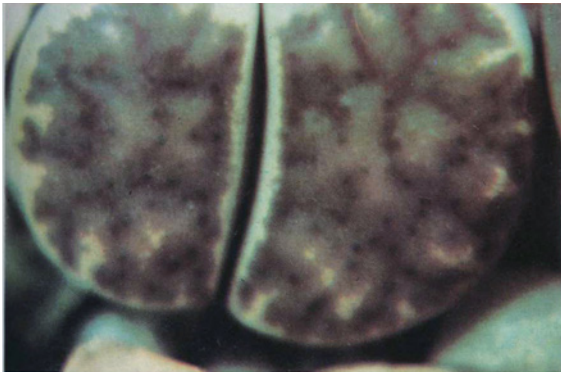
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34



38



35



39



36



37

PLATE III
Lithops bromfieldii L. Bol. (34–37)

Cape Province: Gordonia Division, near Upington on the Orange River. (See Analytical Key Map-4 c)

Found by H. Bromfield, 1934.

This species is closely allied to *Lithops insularis* and can be distinguished from the latter which is dark green brown, by its lighter yellowish red brown appearance.

Flowers yellow.

Lithops brevis L.Bol. (38–39)

Cape Province: Little Namaqualand, Hill 5 miles southeast of Viools Drift on the Orange River. (See Analytical Key Map-4 a)

Found by Mr. N. S. Pillans

Held to be identical with or very closely connected to *Lithops dinteri* which, according to Professor Nel, has more prominent red dots.

Flowers yellow.



41



44



45



42



43



46



PLATE IV

Lithops christinae de Boer (41-43)

South West Africa: 25 km. west of Maltahohe. (See Analytical Key Map- 2 b). (*Succulenta*, 1958, page 2).

Coll: Dr. A. L. Geyer and Mrs. A. E. Geyer-Joubert, June 1957.

Named for Mrs. Christina DuToit-Reitz on whose farm the plant was found.

Flowers yellow.

This plant, although different in color and design, appears to relate in some of its characteristics to the *L. schwantesii* group.

(Photo No. 40 Wm. J. Tijmens)

Lithops comptonii L.Bol. (44-47)

Cape Province: Ceres Karoo, near Karoopoort. (See Analytical Key Map-6 a)

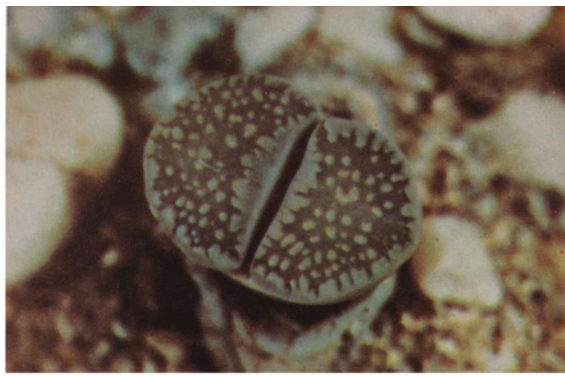
Named after Dr. R. H. Compton, Director of the Botanic Gardens, Kirstenboch, South Africa.

Flowers yellow.

(Photo No. 47 C. B. Dugdale)

47





48



49



50



51



52



53

PLATE V

Lithops deboeri Schwant. (48–51)

Habitat unrecorded.

In its markings and design this species seems to exhibit the same characteristics as *L. weberi*. They differ however, in color and in flower. *Lithops weberi* is predominantly green in color and has yellow flowers. *Lithops deboeri* is blue grey in color and has white flowers. (*Succulenta*, 1954, pg. 52–54)

Lithops dinteri Schwant. (52–53)

South West Africa: Near Witsand, Eendoorn, South of Warmbad. (See Analytical Key Map–3 b)

Found by E. Rusch in 1926.

This species is characterized by a number of fulgent blood-red dots level with the surface of the windows.

Flowers yellow.

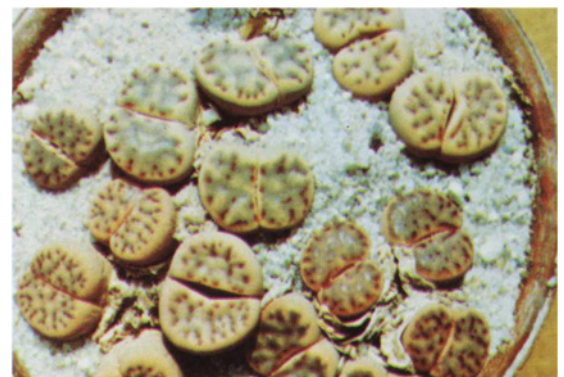
Lithops dinteri var. *multipunctata* de Boer (54–55)

South West Africa: 10 miles north of the Orange River and 30 miles south east of Warmbad. (*Succulenta*, Feb. 199, p. 21)

Coll: V. Pringle (Bedford) and A. A. Roux (Keimoes), May 1963.

A new variety with a greater number of red dots.

(Photo No. 54 H. W. de Boer)



54



55



57



58



59



60



PLATE VI

Lithops divergens L.Bol. (59–60)

Cape Province: Little Namaqualand, Van Rhynsdorp Division; Knersvlakte 30 miles north of Van Rhynsdorp; Niewefontein. (See Analytical Key Map–5 a)

Discovered by Mrs. Eksteen, 1932.

A distinctive type with elongated and widely divergent lobes. Grey green.

Flowers yellow.

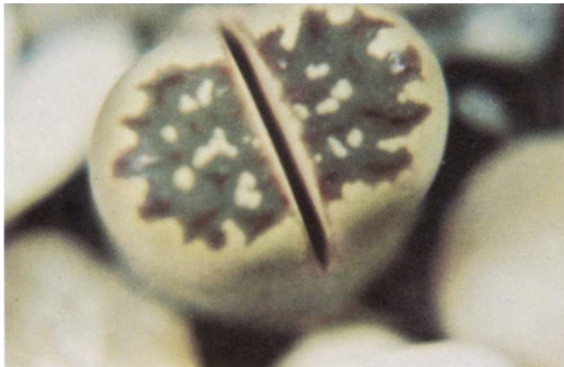
Lithops divergens var. *amethystina* de Boer (56–58)

A purple colored type. (*Succulenta*, 1961, p. 40)

61



62, 63



64, 65

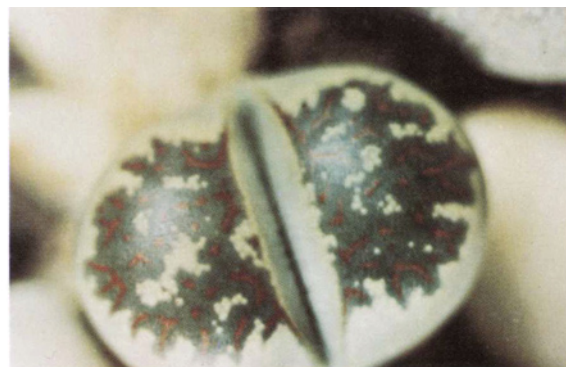


PLATE VII

Lithops dorotheae Nel (61–65)

Cape Province: Namaqualand, Pella near Pofadder. Bushmanland. (See Analytical Key Map-4 a)

Found by Mrs. Dorothea Eksteen near Pella, and named after her. 1938.

Flowers yellow.

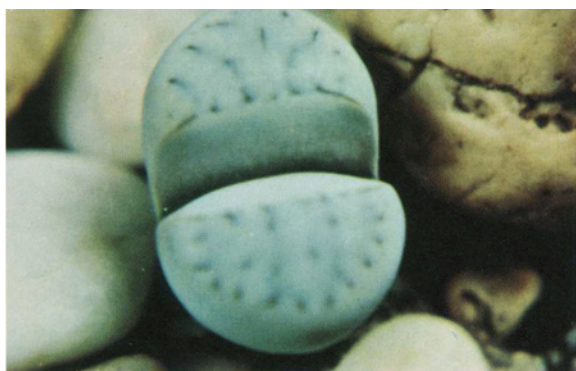
66, 67



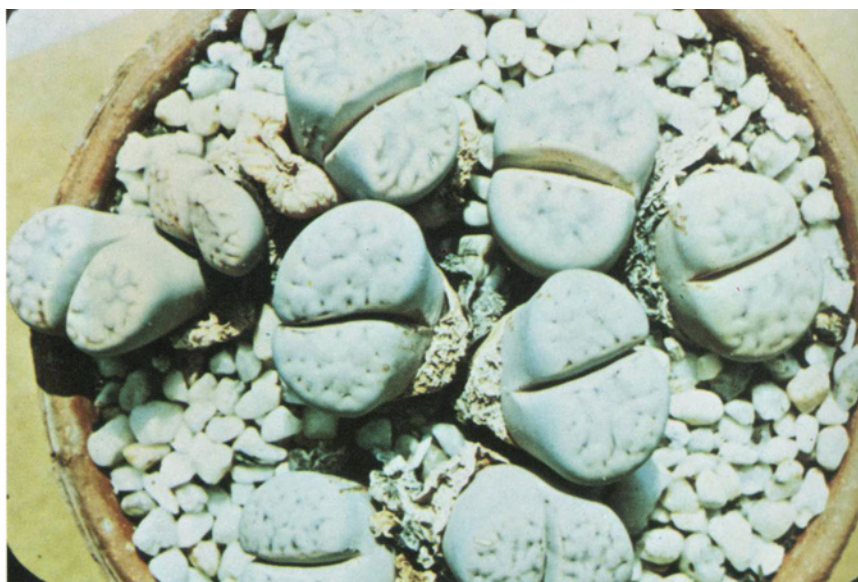
68, 69



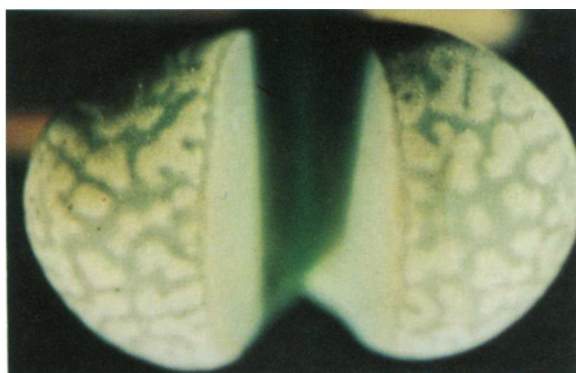
70



71



72



73



PLATE VIII

Lithops erniana Loesch & Tisch. (66–69)

South West Africa: Great Namaland, near Witputz; near Pockenback; 50 miles south of Aus in granite. (See Analytical Key Map—2 c)

Found by Herr Erni of Aus.

Flowers white.

Lithops erniana var. *aiaisensis* de Boer (70–71)

South West Africa: Great Namaland 10 miles east of Aiais. (See Analytical Key Map—2 c)

Coll: R. Littlewood of Worcester, 1961. (*Succulenta*, Jan. 1964, p. 4)

This variety is found bordering the territory where the Karasmontana group occurs and could be considered as a transitional type grading into *L. Karasmontana* var. *opalina*

(Photo No. 71 H. W. de Boer)

Lithops elisae de Boer (72–78)

Cape Province: Little Namaqualand, between Steinkopf and Vioolsdrift. (See Analytical Key Map—4 a)

Found by Dr. A. L. Geyer and Mrs. Geyer in May 1961.

Named after J. J. Elisa Van Den Thoorn of Apeldoorn, Holland.

Related to *L. marmorata* N.E.Br. (*Succulenta*, Oct. 1961, p. 107)

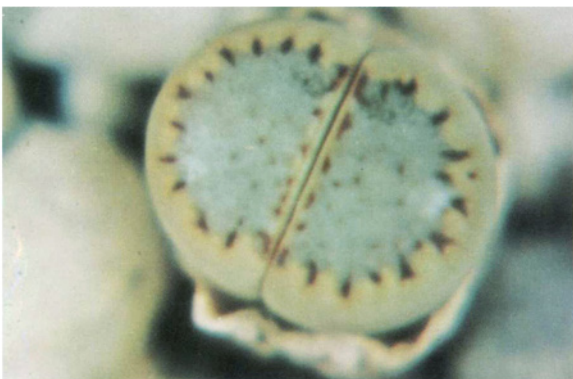
Flowers white.



74



75



76



77



80



81

PLATE IX

Lithops fulleri N.E.Br. (74-81)

Cape Province: Little Namaqualand, Kakarnas, Keimoes; Kenhardt Division, near Kenhardt. (See Analytical Map—4 b)

Discovered by R. E. Fuller, Postmaster at Prieska.

Flowers white.

PLATE IXA

Lithops fulleri var. *brunnea* de Boer (82–85)

Near Pofadder. (See Analytical Map–4 b) (*Succulenta*, June 1962, p. 67)

A brown form with less distinct projections.

Lithops fulleri var. *ochracea* de Boer (86–88)

Near Upington on the north side of the Orange River. (See Analytical Key Map–4 b)

Collected by Mr. A. A. Roux of Keimoes, 1957.

Lithops fulleri var. *chrysocephala* (Nel) de Boer (89)

The exact locality is unknown. (See Analytical Key Map–4 b)

Collected by Mr. Dry of Geelkop. 1939.



82



83



84



85



86



87

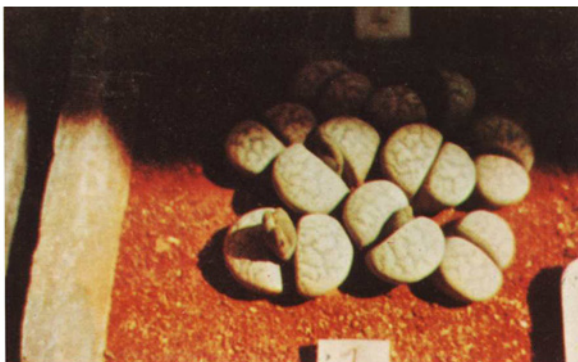


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PLATE X

Lithops franciscii (Dint. & Schwant.) N.E.Br. (90-92)

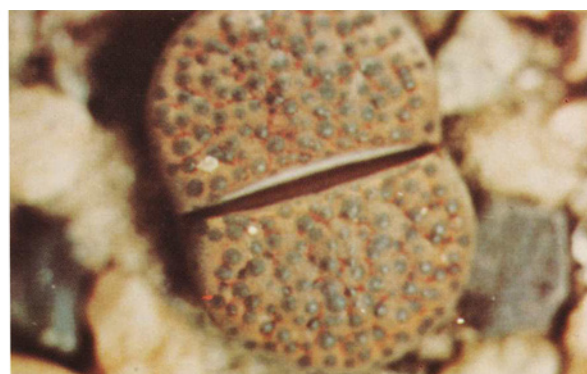
South West Africa: Halenberg near Luderitz Bay; Kavisbergen. (See Analytical Key Map-2 a)

Discovered by Prof. Dinter and named after Franz De Laet of Contich, Belgium.

Flowers yellow.

(Photo No. 91 D. T. Cole)

93



94

95



96

Lithops fulviceps (N.E.Br.) N.E.Br. (93-96)

South West Africa: Great Namaqualand, Great Karasberg Range. (See Analytical Key Map-3 a) at South Narudas in sandy places 4300 feet above sea level.

Discovered by Professor H. H. W. Pearson, 1914.

A distinctive species with top surface thickly sprinkled with large raised round dark green pellucid dots intermixed with thin red lines.

Flowers yellow.

(On following page)

PLATE XI

Lithops gesinae de Boer (97–99)

South West Africa: Namib Mountains east of Luderitz Bay. (See Analytical Key Map–2 b)

Discovered by Herr Herbert Erni of Aus in 1954. Named for Frau Gesina de Boer. Related to *L. franciscii*. (*Succulenta*, Jan. 1955, p. 2)

Flowers yellow.

(Photo No. 97 Tijmens)

Lithops gesinae var. *annae* de Boer & Boom (100)

South West Africa: 20 km. east of the Tiras Plateau. (See Analytical Map–2 b)

Found by Mrs. A. R. Geyer-Joubert, 45 km. east of the locale of *L. gesinae*.

Reduced to varietal status by Dr. de Boer (but see *Succulenta*, 1956, p. 90)

Lithops gracilidelineata Dint. (101–102)

South West Africa: near Khanpforte; near Paradies; north of Swakopmund in Hereroland between Uis and Neinis on the Brandenburg; near Fransfontein and near Witklip. (See Analytical Key Map–1)

This species has a sporadic and wide distribution.

Found by Herr Ernst Rusch, Aug. 1927.

Flowers yellow.

It varies in color according to the mineral composition of the different localities where found, from pure white through grey, yellow, pink and red.

Lithops gracilidelineata var. *waldronae* de Boer (103–104)

South West Africa: 45 km. south east of Walvis Bay. (See Analytical Key Map–1)

Found by Mrs. M. M. Waldron of Walvis Bay in 1960.

This variety has a more rugose or knobby surface and is distinguishable by many fine branching lines in the grooves. (*Succulenta*, Feb. 1963, p. 19)

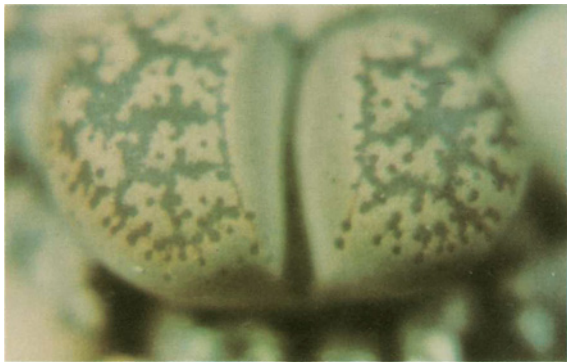
(Photo No. 103 de Boer)



97



98



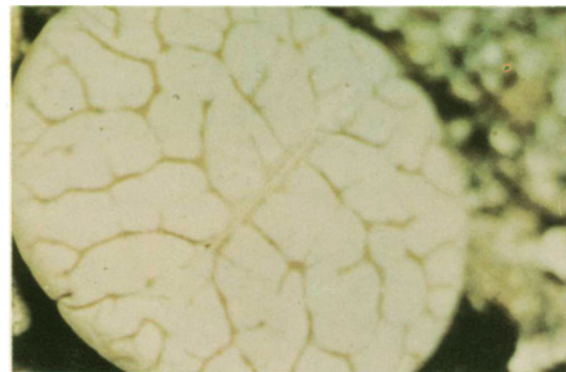
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100



101



102



104



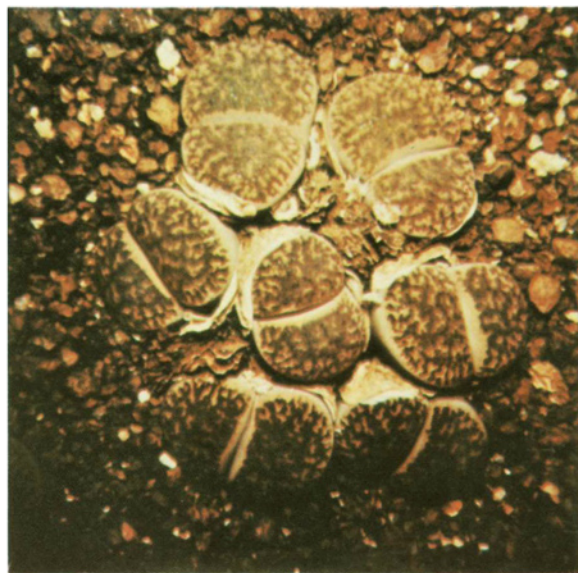
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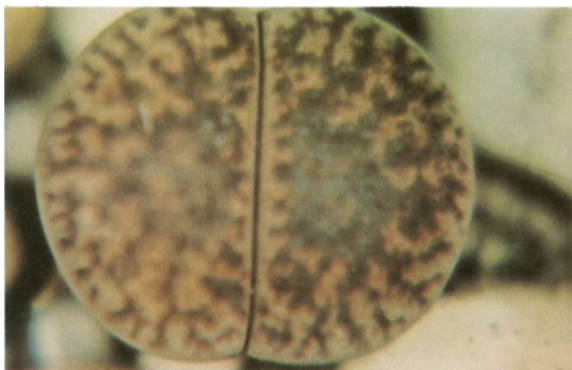
105



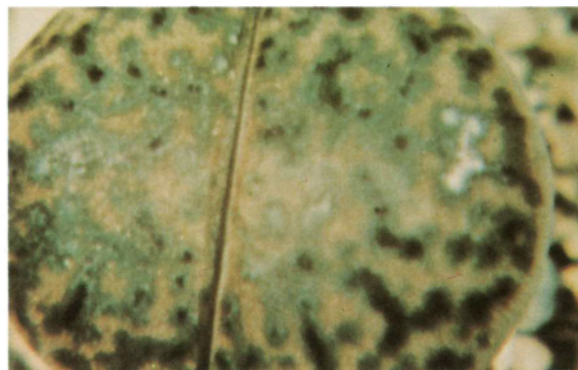
106



107



108



109

PLATE XII

Lithops glaudinae de Boer (105–109)

Cape Province: Griqualand, Hay Division.

Named after Mrs. Glaudina Venter-Jacobs of Pretoria. (See Analytical Key Map-7 a)

Flowers yellow

This species is one of the darkest forms. It is distinguished by the shiny metallic markings on its convex top which give the appearance of a silky gloss. (*Succulenta*, Dec. 1960, p. 129–132)
(Photos No. 105-107 Coil: D. T. Cole)



110

111

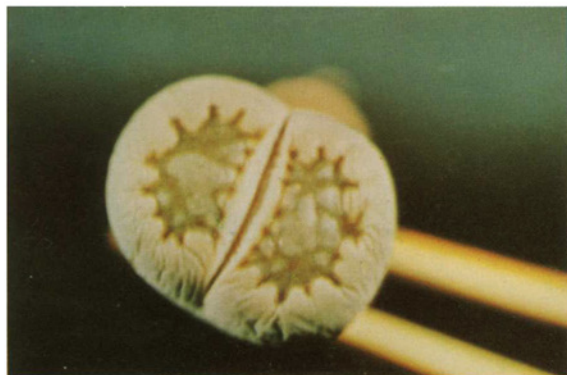
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114

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116



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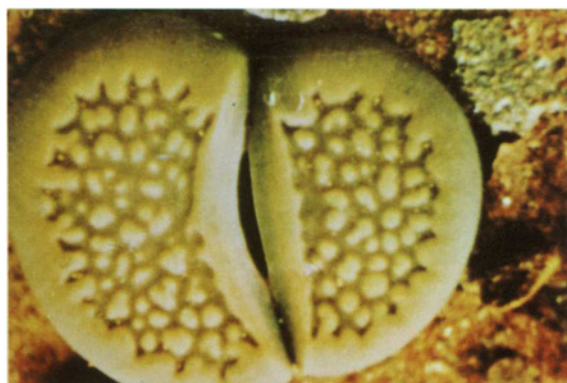


PLATE XIII

Lithops hallii de Boer (110–117)

Cape Province: 30 miles south of Prieska. (See Analytical Key Map–6 b)

Collected by Harry Hall of the National Botanical Gardens at Kirstenbosch and named after him. (*Succulenta*, No. 7, 1957, p. 85.)

Flowers white.

Coll: D. T. Cole (110–111)

Coll: Dugdale (117)



118



110



120

PLATE XIV

Lithops helmutii L.Bol. (118–120) (121 omitted)

Cape Province: Little Namaqualand between Steinkopf & Arrabies. (See Analytical Key Map 4 a)

Found by Herr Helmut Meyer and named after him. 1933.

Flowers golden yellow and scented like Cattleyas.



122



123

PLATE XV

Lithops herrei L.Bol (122–123)

Cape Province: Little Namaqualand: Richtersveld, near Swartwater, near the mouth of the Orange River. (See Analytical Key Map–4 a)

Found by Herr H. Herre, curator of botanical gardens at Stellenbosch, Cape, 1930.

Flowers yellow.

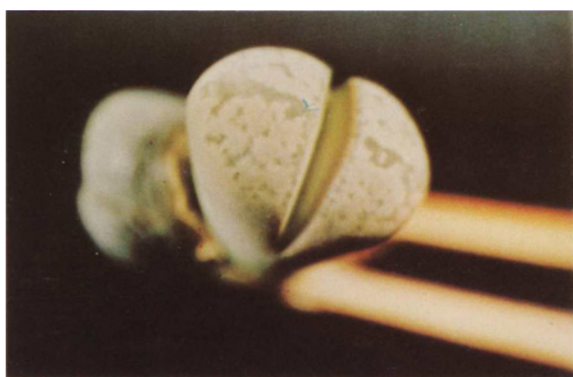
Lithops herrei var. *geyeri* (Nel) de Boer & Boom (124)

Cape Province: Little Namaqualand: Richtersveld, Katberg. (See Analytical Key Map–4 a)

Named after Dr. Geyer. A smaller variety with a large flower.



124



125



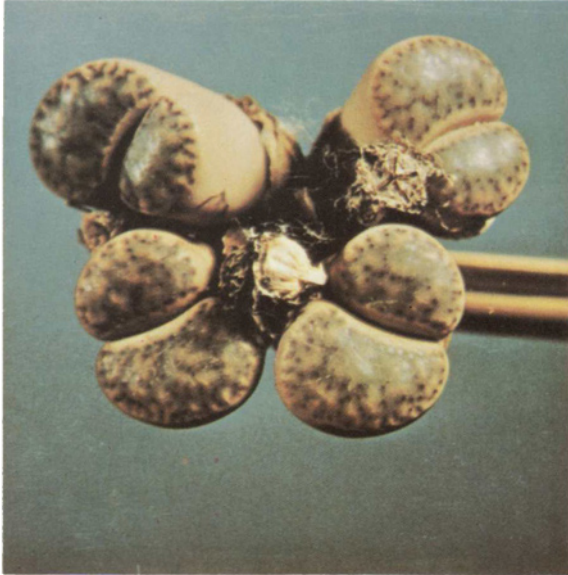
126

Lithops herrei var. *hillii* (L.Bol.) de Boer & Boom (125–126)

Cape Province: Little Namaqualand, Stinkfontein. (See Analytical Key Map–4 a)

A variety with more distinctive islands and with a pinkish tint.

127



128



129



130



131



132

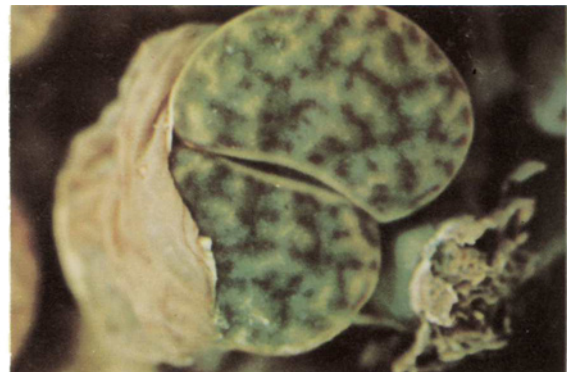


PLATE XVI

Lithops insularis L.Bol. (127–132)

Cape Province: Gordonia Division, on an island in the Orange River near Keimoes. (See Analytical Key Map—4 c)

Discovered by E. Wilmot, 1934.

This species is closely related to *Lithops bromfieldii*.

Flowers yellow.

(Photo No. 128 D. T. Cole)

PLATE XVII

Lithops julii (Dint. & Schwant.) N.E.Br. (133)

South West Africa: Great Namaland, near Vahldoorn, west of Warmbad. (See Analytical Key Map-3 b)

Found by Prof. Dinter and named after Dr. Julius Derenberg of Hamburg, Germany.

Flowers white.

This species has considerable variation in its markings: from a very pale and unmarked form, (called *L. julii* var. *pallida* by some systematists), to a deeply reticulated variety called *L. julii* var. *reticulata*. Dr. de Boer recognizes the following:

Lithops julii var. *reticulata* (Dint. & Schwant.) N.E.Br. (134-136)

This variety has a conspicuously marked network.

(Photo No. 136 Coll: de Boer)

Lithops julii var. *littlewoodii* de Boer (137)

Very much like *L. karasmontana* var. *opalina*.

The brown lines along the cleft are absent in this form.

Lithops julii var. *rouxii* de Boer (138-139)

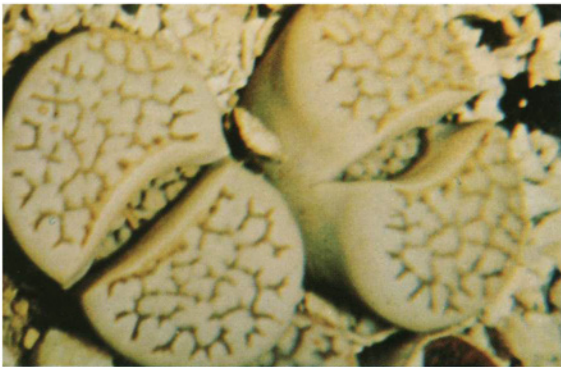
South West Africa: 30 miles south of Warmbad. (See Analytical Key Map-3 b)

Discovered by A. A. Roux of Keimoes and named after him. May 1963.

In appearance this variety begins to show a relationship to *Lithops fulleri*. (*Succulenta*, Oct. 1964, p. 139)



133



134



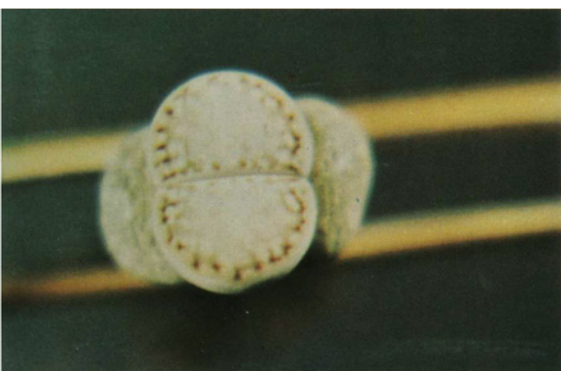
135



136

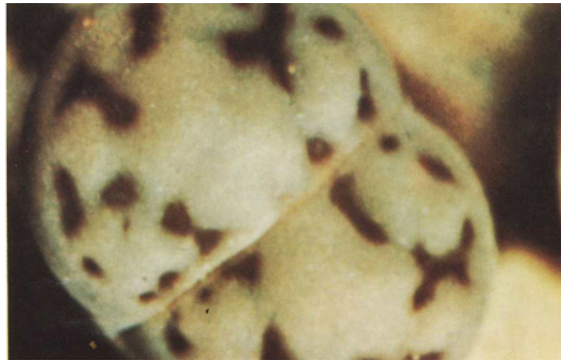


137





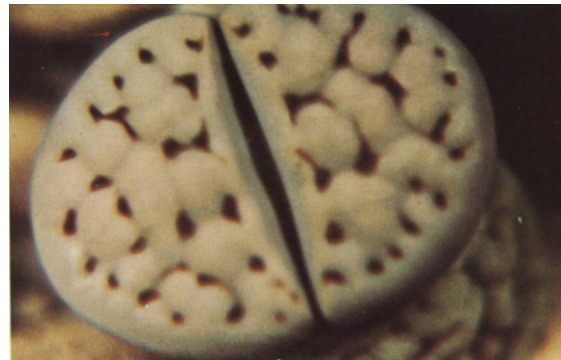
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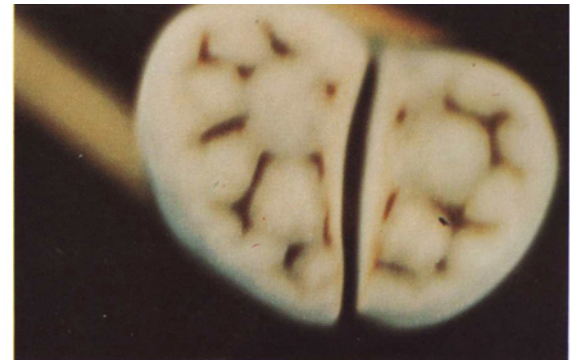
141



142



143



144

PLATE XVIII

Lithops karasmontana (Dint. Schwant.) N .E. Br. (140–146)

South West Africa: 30 miles south west of Warmbad. (See Analytical Key Map–3 b)

Discovered by Professor Kurt Dinter in 1920.

This highly variable species includes the following names which are considered as synonyms by Professor Nel.

L. Mickbergensis Dint. *L. jacobseniana* Schwant. *L. lateritia* Dint.
L. opalina Dint. *L. summitatum* Dint.

Although the above are given specific status by Prof. Schwantes (see *Flowering Stones*, 1957) and Prof. Jacobsen (*Handbook on Succulents*, vol. III) they will herein be considered as varieties in accordance with the determinations of Dr. de Boer. See *Succulenta*, 1961, p. 44 & 52.

Flowers white.



145



146



147



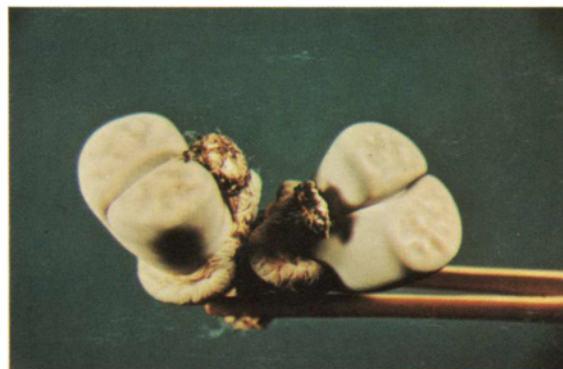
148



149



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151



152



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PLATE XVIII

Lithops karasmontana var. *summitatum* (Dint.) de Boer & Boom (147–150)

South West Africa: Klein Karas Mountains. (See Analytical Key Map–3 a)

Discovered by Professor Kurt Dinter, 1926. (*Succulenta*, 1961, p. 52)

Lithops karasmontana var. *opalina* (Dint.) de Boer & Boom (151–153)

South West Africa: 45 miles west of the Klein Karas Mountains (See Analytical Key Map–3 a) at Eisterbank.

Discovered by Professor Dinter Nov. 1923.



154



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160

PLATE XVIIIIB

Lithops karasmontana var. *mickbergensis* (Dint.) de Boer & Boom (154–160)

South West Africa: East of Mickberg in the Great Karas Mountains. (See Analytical Key Map–3 a)

Found by Herr E. Rusch in Aug. 1926.

This variety is variable and Dr. de Boer has considered as synonyms to be included hereunder, the following:

L. mickbergensis Dint.

L. lateritia Dint.

L. jacobsoniana Schwant. (*Succulenta*, 1961, p. 44)



161



162



163

164



165



PLATE XIX

Lithops lesliei (N.E.Br.) N.E.Br. (161-164)

This species has a very wide distribution.

Transvaal: near Vereeniging, near Pretoria, Klerksdorp, Bloemhof, (See Analytical Key Map-7)

Orange Free State: (See Analytical Key Map-7 a) near Bethlehem, near Senekal, near Verkeerdevelei.

Cape Province: Warrenton, Windsorton, Kimberley.

Discovered by Mr. T. N. Leslie in the Transvaal. 1912.

A very hardy species.

Flowers yellow.

Dr. de Boer has established a number of varieties for this species. (See *Succulenta*, 1962, pages 81 & seq.)

Lithops lesliei var. *luteoviridis* de Boer (165)

Near Magaliesburg, Transvaal. (See Analytical Key Map-7)

Collected by Professor D. T. Cole, 1961.

Yellow green in color.

(Photos No. 161, 164, 165 D. T. Cole)

PLATE XIXA

Lithops lesliei var. *venteri* (Nel) de Boer & Boom (166-167)

(*Lithops venteri* Nel)

Griqualand West: Boetsap. (See Analytical Key Map-7 a)

Named after Major Venter of Kimberley, 1939.

166



167



168



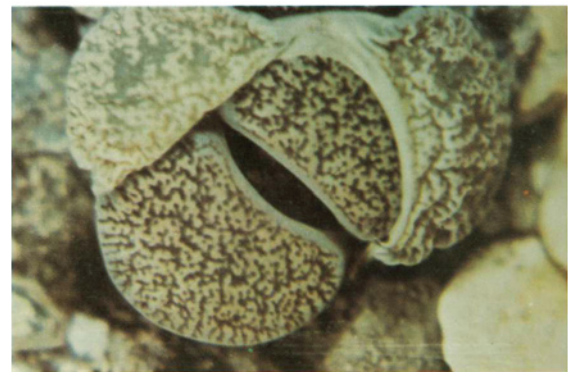
169



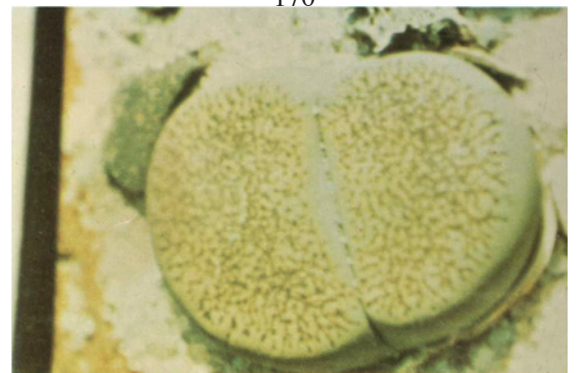
172



170



171



Lithops lesliei var. *minor* de Boer (168–169)

Transvaal: between Rustenberg & Ventersdorp. (See Analytical Key Map-7)

Coll: C. J. Blom, 1954.

A small growing species about half the normal size, cinnamon brown in color. Flowers are yellow, but shown in Fig. 169 is a rare white flowering form of *L. lesliei* var. *minor* discovered by Professor Cole. (See *Nat. Cactus & Succulent Journal*, Mar. 1962, Vol. 17, P. 5)

(Photos 168–169 D. T. Cole)

Lithops lesliei var. *maraisii* de Boer (170–172)

Cape Province: 30 miles north west of Barkley West, Barkley West district, Hay Division. (See Analytical Key Map-7 a)

Coll: Dr. D. T. Marais, June 1961.

(Photo 172 H. W. de Boer)

173



174

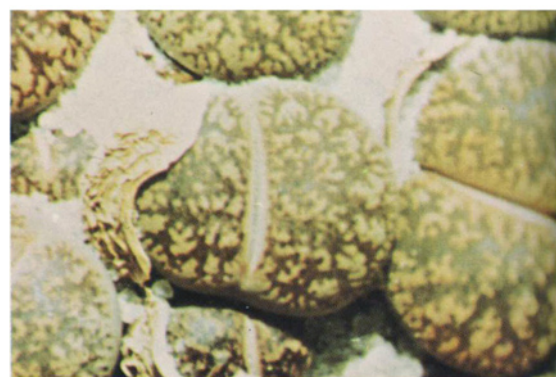
178



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176



177

PLATE XIXB

Lithops lesliei var. *rubrobrunnea* de Boer (173–176)

Transvaal; near Randfontein. (See Analytical Key Map–7)

Collected by Professor Desmond T. Cole of Johannesburg, 1961.

A red brown colored form with less branching in the green brown windows.

Lithops lesliei var. *hornii* de Boer (177–178)Cape Province; near Modder River, 30 miles south of Kimberley. See Analytical Key Map–6 b) (*Succulenta*, Mar. 1966, p. 37)

Coll: Mr. H. A. Horn of Petrusville, Dec. 1964.

A form with top surface similar to *L. lesliei* var. *venteri*, except that the color is brown yellow instead of grey.

(Photo No. 178 Coll: H. W. de Boer)

PLATE XX

Lithops localis (N.E.Br.) Schwant. (179–182)

Cape Province: Beaufort West Division, near the Gamka River. (See Analytical Key Map–5 b)

Found by Barke.

Bodies small, fawn colored. Flowers yellow.

Dr. de Boer has established the following new names as varieties:

Lithops localis var. *peersii* (L.Bol.) de Boer & Boom (183)*Lithops peersii*, L.Bol. 1929)

Cape Province: Willowmore District near Miller; Laingsburg; near Prince Albert. (See Analytical Key Map–5 b)

Found by V. S. Peers, 1929.



179



180



181



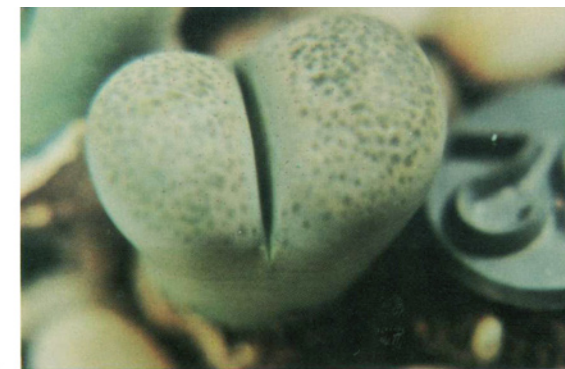
182



183



184



185

Lithops localis var. *terricolor* (N.E.Br.) de Boer & Boom (184–185)
(*Lithops terricolor* N.E.Br. 1922)

Cape province: Somerset East Division near Springbok Flats; Laingsburg Division, near Grootfontein; Willowmore Division, near Millerstation. (See Analytical Key Map-5 b) Grey to yellow green in color.

This species has the widest distribution in the Cape Province.
(Photo No. 179 and 180: D. T. Cole)

186



187



188



189



190

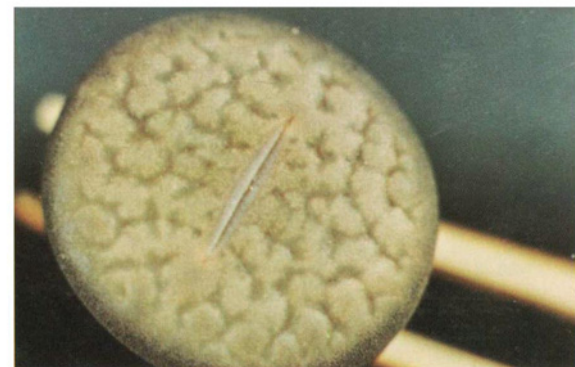


PLATE XXI

Lithops marginata Nel (186–190)

Original locale unspecified. Now designated by Dr. de Boer as occurring near Hopetown on the Orange River (See Analytical Key Map-4 b) (See *Succulenta*, April 1960, page 43)

Found by Herr M. Otzen.

Numerous red blood lines and spots in the grooves.

Flowers yellow.

(Photos No. 186–187 Coll: D. T. Cole)

191



192



193



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196



PLATE XXII

Lithops marmorata (N.E.Br.) N.E.Br. (191–195)

Cape Province: Little Namaqualand; Umdaus; Port Nolloth. (See Analytical Key Map–4 a)

Flowers white.

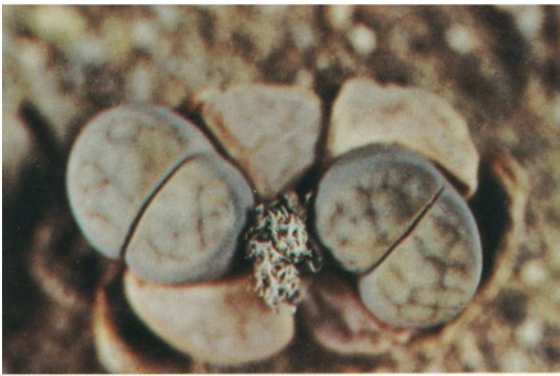
Included herein is *Lithops framesii* L. Bol. (196)

Little Namaqualand, 20 miles east of Springbok on the road to Pofadder (See Analytical Key Map–4 a)

Found by Mr. Ross Frames, 1930.

A form with dark grey windows and islands.

197



198



199



200



201



202



203

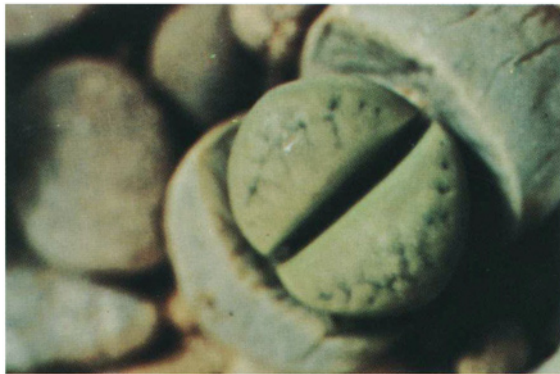


PLATE XXIII

Lithops marthae Loesch. & Tisch. (197–198)

South West Africa: Great Namaland, in Granite Mountains south of Pock-enbank, 50 miles south of Aus. (See Analytical Key Map–2 c)

Found by Herr F. Erni, 1931.

Named after his wife, Frau Martha Erni.

Flowers yellow.

Lithops mennelli L.Bol. (199–201)

Cape Province; Gordonian Division, Louisvale near Upington. (See Analytical Key Map–4 c)

Found on quartz covered slopes by Mr. Brian Mennell, April 1934.

Flowers yellow.

This species has very distinctive dark markings.

Lithops meyeri L.Bol. (202–204)

Cape Province: Little Namaqualand, Richtersveld, Brakfontein. (See Analytical Key Map–4 a)

Named after the missionary Herr G. Meyer who discovered this species in Oct. 1931.

A greenish type with wide gaping convex lobes. Tops faintly marked.

Flowers yellow.

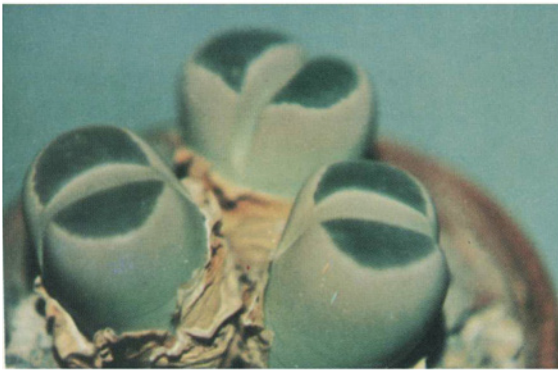
204





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208

PLATE XXIV

Lithops olivacea L.Bol. (205–208)

Cape Province: Little Namaqualand, Bushmanland, Kenhardt Division near Kakamas, Pofadder. (See Analytical Key Map–4 b)

Found by E. R. Fuller, 1928.

Flowers yellow.

(Photo No. 208 D. T. Cole)



209



210



211



212



213

PLATE XXV

Lithops optica (Marl.) N.E.Br. (209)

South West Africa: Great Namaland; near Prince of Wales Bay, near Luderitz Bay. (See Analytical Key Map-2 a)

Discovered by Professor Marloth.

Flowers white.

This species grows close to the sea shore where there is a daily misty rain.

Lithops optica forma rubra (Tisch.) Rowley (210-211)

Found 30 miles south of Luderitz Bay. (See Analytical Key Map-2 a 1925)

This rare species has bodies of purple red and is always found growing with *Lithops optica* and occurs at a ratio of 1:1000. The petals are white with pinkish tips.

Lithops otzeniana Nel (212-213)

Cape Province: Bushmanland, Brakfontein, 30 miles from Loeriesfontein. (See Analytical Key Map-5 a)

Found by Professor G. C. Nel, 1937.

Named after Herr M. Otzen

Flowers yellow: Large lobes in the margins of the windows distinguish this species.

214



217



216



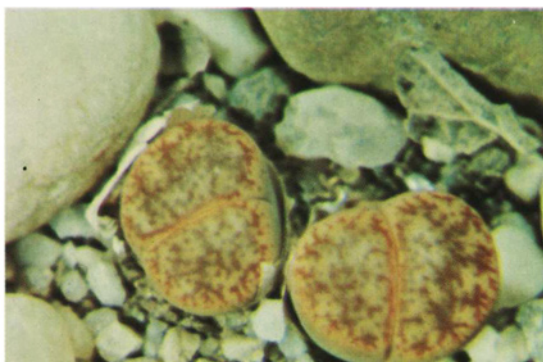
217



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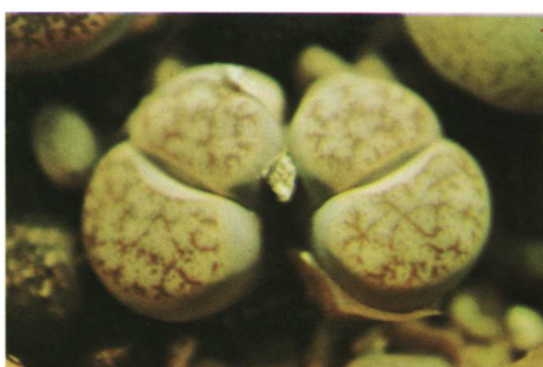


PLATE XXVI

Lithops pseudotruncatella (Berger) N.E.Br. (214–218)

South West Africa; Damaraland, Auas Mountains near Windhoek, Lichtenstein; Khomas Plateau and eastern extensions; Eros Mountains. (See Analytical Key Map-1-2 b)

This species has a wide distribution and a number of species have been included herein as varieties by Dr. de Boer. (*Succulenta*, 1961, p. 65–69)

Lithops pseudotruncatella var. *pseudotruncatella* (219–221)
(*Lithops alpina* Dint.)

Discovered on the summit of the Ruschberg by E & O Rusch, 1925. Also found on the road from Windhoek to Rehoboth. (See Analytical Key Map-2 b)

Flowers yellow.

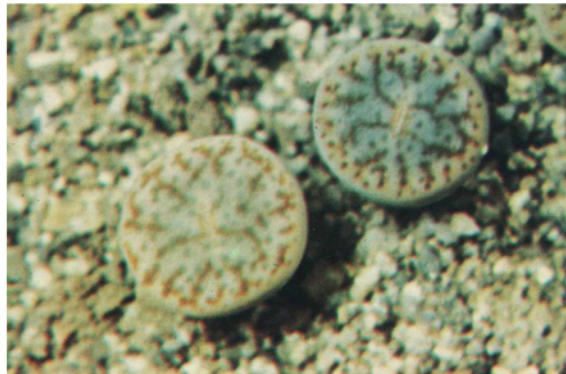
(Photo No. 216-217 Seedling)



224



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PLATE XXVIA

Lithops pseudotriincatella var. *pulmonuncula* (Dint. & Jac.) Jac. (222–224)
(*Lithops pseudotruncatella* ssp. *pulmonuncula* Dint. ex Schwant.)

Rehoboth on the Farm Friedental. Western slopes of the Khomas Plateau.
(See Analytical Map–2 b)

Found by W. Triebner.
(Photo No. 224 Seedling)

Lithops pseudotruncatella var. *elizabethae* (Dint.) de Boer & Boom
(*Lithops elizabethae* Dint.) (225–226)

Okosangomingo on the southern slopes of the Waterberg Mountains. (See
Analytical Key Map–1)

Found by Frau Elizabeth Schneider and named after her.
Coppery red.

Lithops pseudotruncatella var. *edithae* (NE.Br.) de Boer & Boom
(*Lithops edithae* N.E.Br.) (227–229)

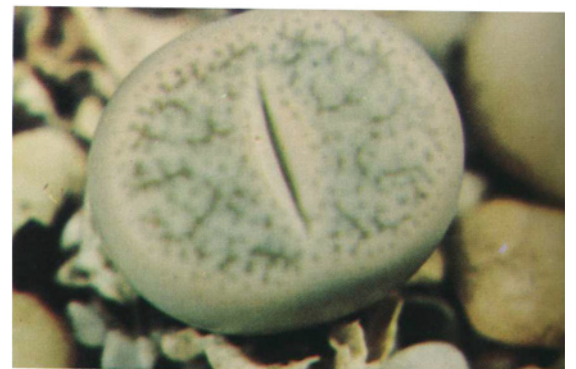
60 miles east of Windhoek between Rietfontein and Langebeen. (See Ana-
lytical Key Map–2 b)

Found by W. Triebner, 1935

Blue grey type with vague markings.



229



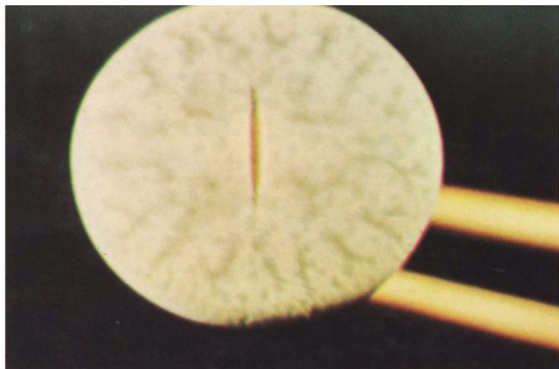
230



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PLATE XXVIB

Lithops pseudotruncatella var. *dendritica* (Nel) de Boer & Boom (230–231)

(*Lithops dendritica* Nel)

Eastern Nauchas, 65 miles west of Rehoboth. (See Analytical Key Map–2 b)

Found by Herr Otzen.

A type with prominent brown dendritic markings. Top grey brown.

A form in cultivation as *Lithops farinosa* is to be included herein.

Lithops pseudotruncatella var. *volkii* (Schwant.) de Boer & Boom (232–233)

(*Lithops volkii* Schwant. ex Jacobsen)

Bastardland, at Nabitsaus Farm in Rehoboth District, near Bergland station. (See Analytical Key Map–2 b)

Found by Herr W. Giess and named after Professor D. O. H. Volk of Wurtzburg. 1954.

Dove grey to blue grey type with or without faint blue markings. (Photo No. 232 Seedling)

Lithops pseudotruncatella var. *brandbergensis* de Boer (see *Succulenta*, 1963, page 51) (234)

Brandberg 190 km. north of Swakopmund. (See Analytical Key Map–1) Coll. J. Rudner June 1955

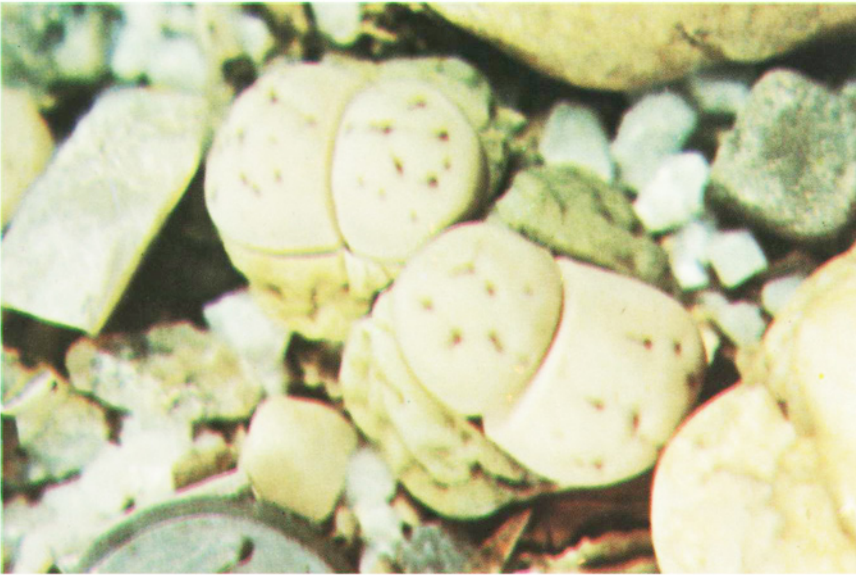
Lithops pseudotruncatella var. *mundtii* (Tisch.) Tisch. Ex. Jac. (235)

South West Africa: Farm Mundt, near Witvley, east of Windhoek. (See Analytical Key Map–1)

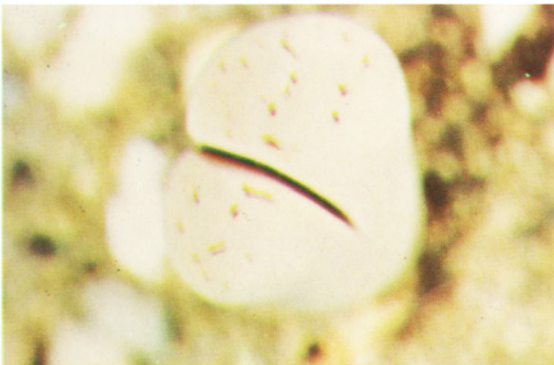
Yellow brown type with distinct dendritic markings. The lobes are unequal and the fissure runs completely across.



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PLATE XXVII

Lithops ruschiorum (Dint. & Schwant.) N.E.Br. (236–237)

South West Africa: near Khan copper mine, 10 km. west of Roessing and the Old State Railway. (See Analytical Key Map–1)

Discovered by Herr Ernst Rusch, 1923.

Flowers yellow.

Dr. de Boer recognizes two varieties as follows:

Lithops ruschiorum var. *lineata* (Nel) de Boer & Boom (238)

South West Africa: north of Swakopmund. (See Analytical Key Map–1)

This form has a number of impressed orange lines.

Lithops ruschiorum var. *nelii* (Schwant.) de Boer & Boom (239)

South West Africa: 12 miles east of Cape Cross, 95 miles north of Swakopmund. (See Analytical Key Map–1)

Discovered by W. Triebner of Windhoek, 1939.

A small sized variety usually without markings.



240



241

PLATE XXVIII

Lithops salicola L.Bol. (240-246)

Orange Free State: Fauresmith Division, on the farm Rose Marie, near Luckhoff, on salty plains. (See Analytical Key Map-6 b)

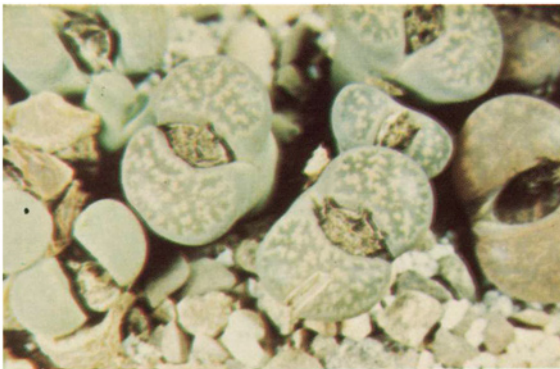
Discovered by Mr. J. C. Verdoorn, 1935.

This variable species lies partly submerged in brackish pans of water during the rainy season.

Flowers white.

(Photos No. 240-241 D. T. Cole. 243 C. B. Dugdale)

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PLATE XXVIII

Lithops salicola var. *reticulata* de Boer (247-251)

Cape Province: near Kraankuil, 45 km. south of Hopetown. (See Analytical Key Map-6 b)

Coll. Dr. A. L. Geyer, 1959.

This variety has a grey to red brown network. In some aspects it bears a resemblance to *Lithops hallii*, but the latter is not windowed. (*Succulenta*, July 1960, p. 79-81)
(Photo No. 250 Seedlings)

Lithops steineckeana Tisch. (252)

South West Africa: Great Namaland. Exact locality unknown.

A nearly egg shaped variety, sub-bilobed with fissure compressed. Grey to brown ochre in color with brown markings. Raised by Herr Steineck at Ludwigsburg near Stuttgart Germany. According to Schwantes this species may be a hybrid with some relationship to *Lithops marthae*.

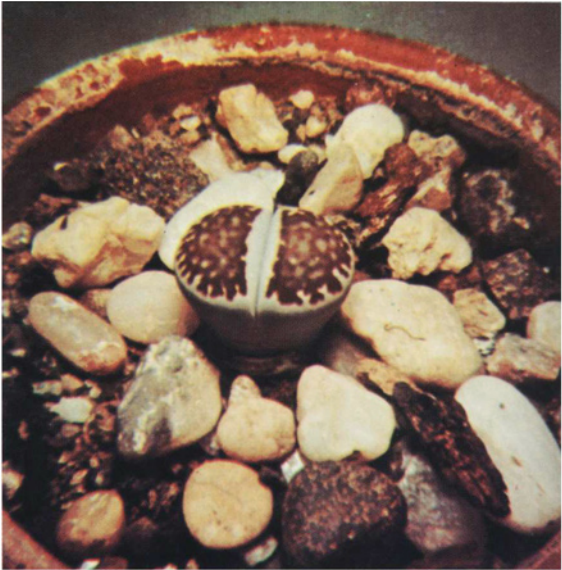
Dr. de Boer suggests that it may be a hybrid of *L. pseudotruncatella* X *L. ruschiorum*.

See also *Notes on Lithops* by B. Fearn (*Natl. Cactus & Succ. Journal*, Dec. 1966, p. 104.)

Flowers yellow.
(Photo No. 252 Coll: de Boer)



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252



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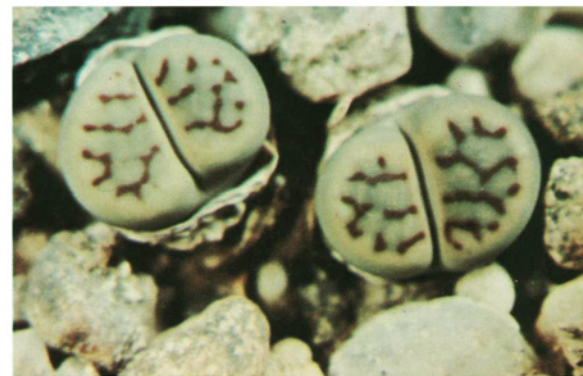
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257

PLATE XXIX

Lithops schwantesii Dinter (253–256)

South West Africa: Great Namaland, between Kunjas and Barbi; 80 miles west of Bethanien, Kruger Puts. (See Analytical Key Map–2 b)

Discovered by Herr Ernst Rusch, 1926.

Flowers yellow.

Dr. de Boer includes herein *Lithops kuibisensis* Dint. Ex. Jac., an undescribed species.

This variant of *Lithops schwantesii* is characterized by a reddish brown top with a bluish tint at the center.

Lithops schwantesii var. *kunjasensis* (Dint.) de Boer & Boom (257–258)

(*Lithops kunjasensis* Dint.)

South West Africa: 90 km. north-east of Aus, Kunjas near Helmeringhausen. (2 c)

Found by Herr Ernst Rusch, Aug. 1926.

A variety with more pronounced and darker grooves.

Lithops schwantesii var. *triebneri* (L. Bol) de Boer & Boom (259–260)

(*Lithops triebneri* L. Bol)

South West Africa: Namib, Tiras Mountains, on the summit of Menatchek Mountain. (See Analytical Key Map–2 c)

Found by Herr W. Triebner, March 1933.

Yellow brown is its characteristic color.

(Photo No. 253 Wm. J. Tijmens)



258



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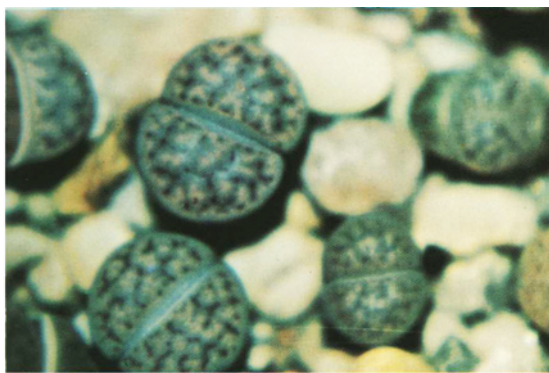
263



264



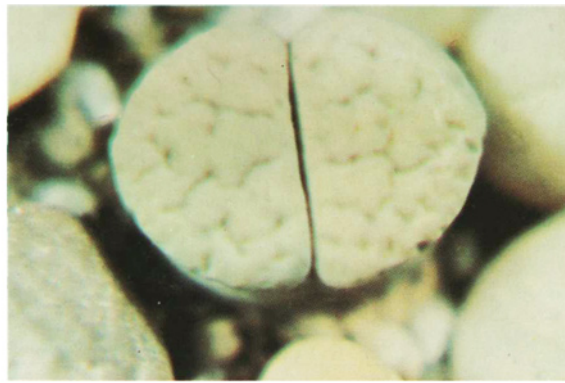
266



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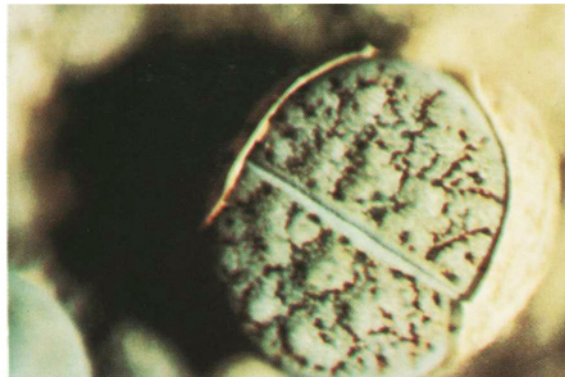


PLATE XXIXA

Lithops schwantesii var. *urikosensis* (Dint.) de Boer & Boom (261–263)

(*Lithops urikosensis* Dint.)

South West Africa: Bastardland, Urikos Farm 10 km. west of Maltahohe.
(See Analytical Key Map–2 b)

Discovered by Herr E. Rusch, Aug. 1926.

A cement colored variety with brownish markings.

Lithops schwantesii var. *nutupsdriftensis* de Boer (264–265)

South West Africa: Great Namaland, Nutupsdrift. 17 miles west of Maltahohe.

Collected by W. Gebser, Nutupsdrift, 1960.

Seedlings of a new variety. (*Succulenta*, Aug. 1964)

Lithops schwantesii var. *rugosa* (Dint.) de Boer & Boom (266)

(*Lithops rugosa* Dint.)

South West Africa: near Helmeringhausen on the Sinclair Farm. See Analytical Key Map–2 c)

Found by Herr E. Rusch, Aug. 1926.

Amethyst colored with distinct grooves.

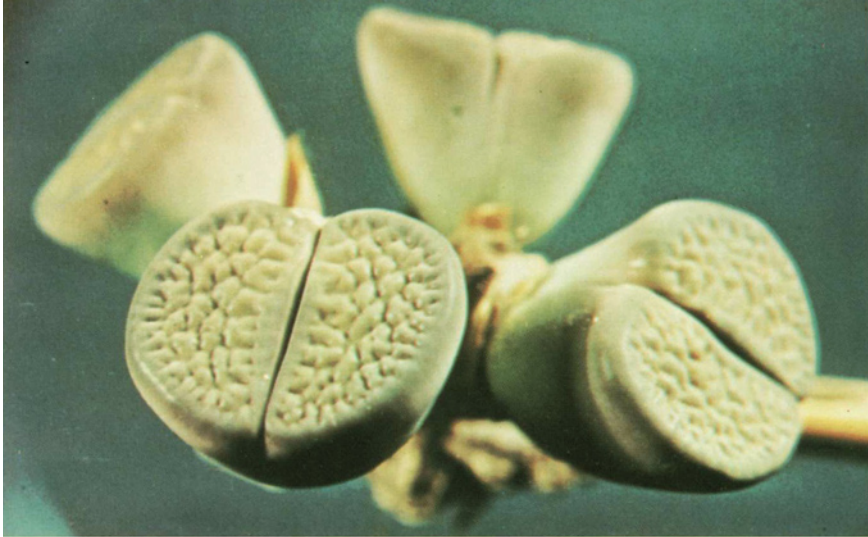
Lithops schwantesii var. *gebseri* de Boer (267)

South West Africa: Great Namaland, Estdorfdank, 50 miles southeast of Maltahohe

Collected by W. Gebser, Nutupsdrift, 1960.

Seedling of new variety. (*Succulenta*, Aug. 1964)

(Photo No. 264 C. B. Dugdale)



268



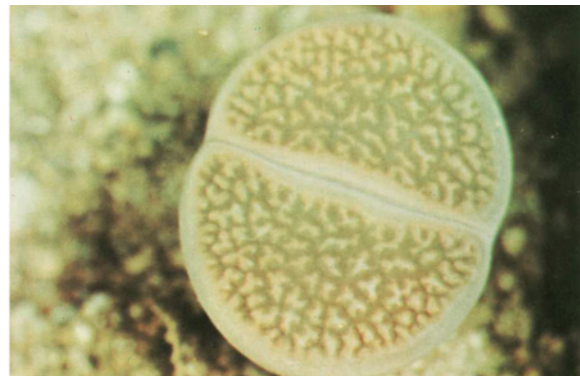
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PLATE XXX

Lithops turbiniformis (Haw.) N.E.Br. (268–274)

Cape Province: Prieska Division, near Prieska; near Britstown; near Strydenburg; near Kraankuil; Zand Vlei. (See Analytical Key Map–6 b)

Found by Burchell Sept. 1811 at Zand Vlei. This is the first recorded species of *Lithops* ever found and was named by Lord Haworth, *Mesembryanthemum turbiniforme*. Subsequently it was renamed *Lithops turbiniformis* by N. E. Brown, 1922.

This species has a wide distribution and a number of varieties have been established by Dr. de Boer.

Flowers yellow.

(Photo No. 270 C. B. Dugdale)

275



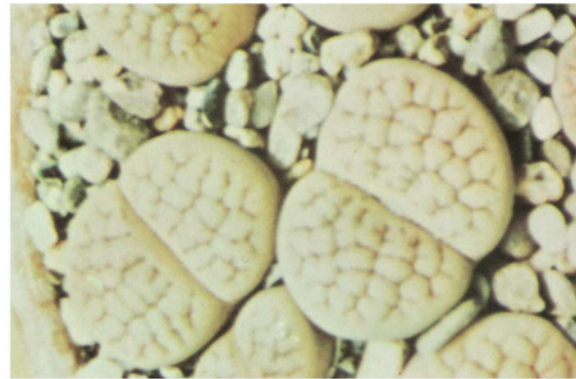
276



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PLATE XXXA

Lithops turbiniformis var. *lutea* de Boer (275–279)

Cape Province: Groblershoop on the Orange River. (See Analytical Key Map–6 a)

Collected by Prof. D. T. Cole of Johannesburg, Feb. 1961

Brown red markings are sharply contrasted against the yellow brown surface.

Lithops turbiniformis var. *brunneo-violacea* de Boer (280–281)

Cape Province: Griqualand West, 30 miles south west of Griquatown. (See Analytical Key Map–7 a)

Coll: Prof. D. T. Cole, Feb. 1961.

A dark brown violet type with shallow grooves.

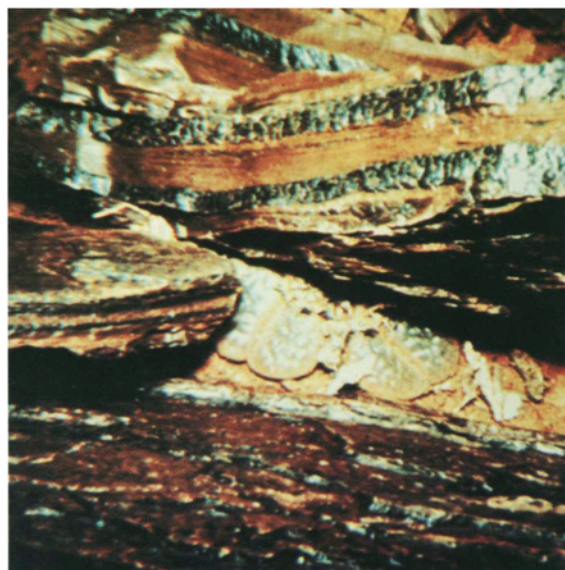
282



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PLATE XXXB

Lithops turbiniformis var. *subfenestrata* de Boer (282–286)

Cape Province: near Prieska. (See Analytical Key Map–6 b)

Coll: Prof. D. T. Cole, Feb. 1961.

(Photo Nos. 282–284 D. T. Cole)

A dark grey brown form with shallow markings forming a partially transparent dark window. (*Succulenta*, April 1964, p. 50)

(Photo No. 285 de Boer)

PLATE XXXI

Lithops verruculosa Nel. (287–288)

Cape Province: Kenhardt District. 1943. (See Analytical Key Map–6 a)

Flowers range in color from white, through pale lime yellow, straw yellow, orange yellow, salmon pink with tints of mauve. It is the only species showing this variety.

Grey warts can be observed in the grooves. Dr. van der Westhuizen, 1939.

Dr. de Boer has established *Lithops inae* as a variety hereunder.

Lithops verruculosa var. *inae* (Nel) de Boer & Boom (289–293)

Cape Province, Prieska District. (See Analytical Key Map–6 a)

Named for Lady Ina Oppenheimer.

Easily distinguished by slightly raised deep red dots or flecks unobserved in any other species.

Lithops verruculosa var. *glabra* de Boer (294–295)

Cape Province: near Kenhardt. (See Analytical Key Map–6 a)

Coll: G. R. McLachan, 1962; V. L. Pringle and A. A. Roux, May 1963.

(*Succulenta*, July 1966, p. 107)

A windowed variety without red dots, with a pale bluish top surface.

(Photo No. 294 H. W. de Boer)



287



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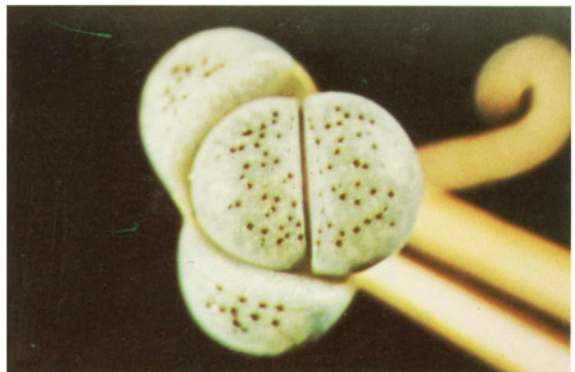
290



292



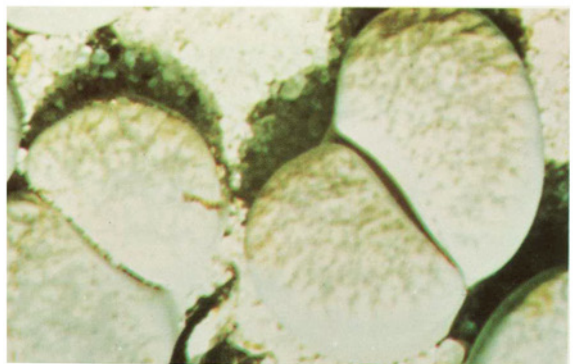
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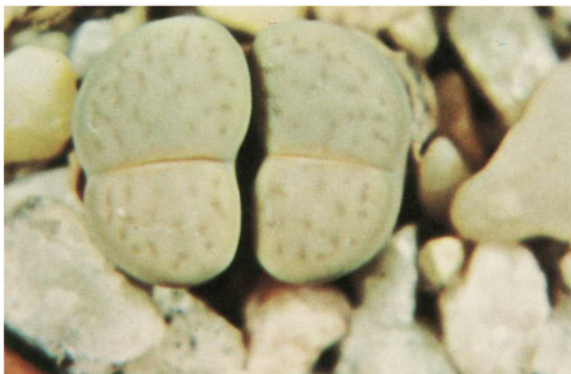


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299



PLATE XXXII

Lithops viridis luckhoff (296–297)

Cape Province: between Calvinia and Loeriesfontein. (See Analytical Key Map–5 a)

Found by H. A. Luckhoff and L. Hill, Oct. 1956.

Flowers yellow.

Lithops vallis-mariae (Dint. & Schwant.) N.E.Br. (See Analytical Key Map–2 b) (298–299)

South West Africa: Bastardland, on Brandt's Alt-Mariental Farm, 8 miles east of Mariental.

Found by Mrs. Beetz, 1923.

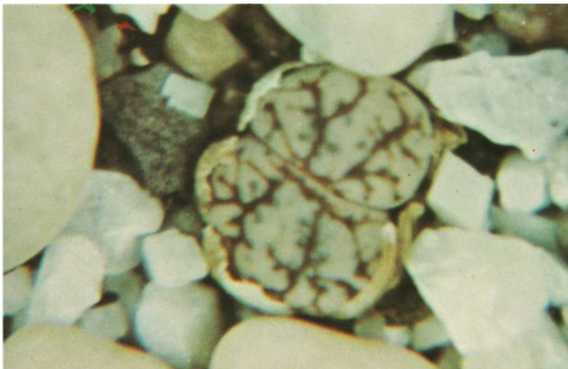
Flowers yellow.



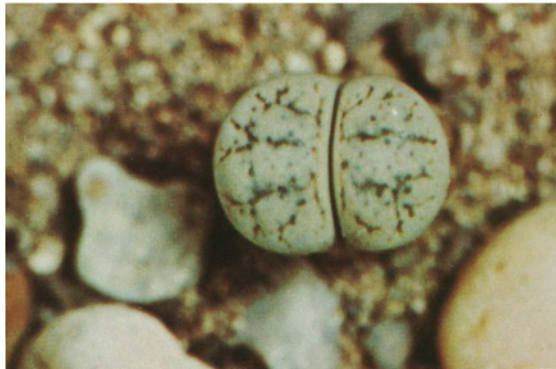
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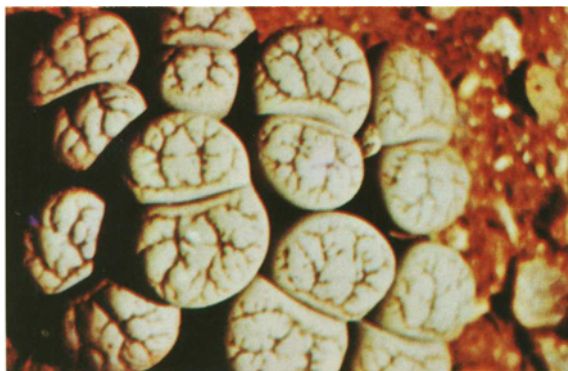
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302



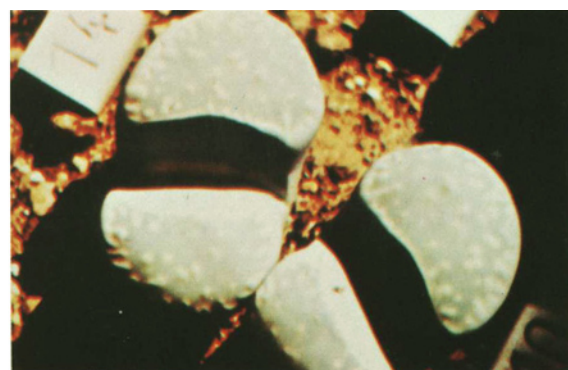
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PLATE XXXIII

Lithops villetii L. Bol. (300–301)

Cape Province: Calvinia Division near Loeriesfontein. (See Analytical Key Map–5 a)

Found by C. T. Villet, 1938.

An extreme windowed type.

Flowers white.

Lithops wernerii Schwant. & Jacobs. (302–304)

South West Africa: Damaraland, at the foot of Erongo Range (See Analytical Key Map–1)

25 miles west of Usakos west of Karibib.

Smallest of the *Lithops* species, about the size of a pea.

Flowers yellow.

(Photo No. 304 D. T. Cole)

Lithops weberi Nel (305–306) Cape Province: Calvinia, Ceres Karoo.

(See Analytical Key Map–5 a)

Found by Professor Nel, Sept. 1939.

Named after Herr Weber of Calvinia.

A green windowed type in a variety of shades of green, grey, reddish and violet. This species is closely allied to *Lithops otzeniana*.

Flowers yellow.

307



308



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310



PLATE XXXIV

Dinteranthus vanZyliae (L.Bol.) Schwant. (307–309)(*Lithops vanZyliae* L.Bol)

Cape Province: Bushmanland, near Pofadder. (See Analytical Key Map–4 a)

Discovered by G. H. Van Zyl, 1931.

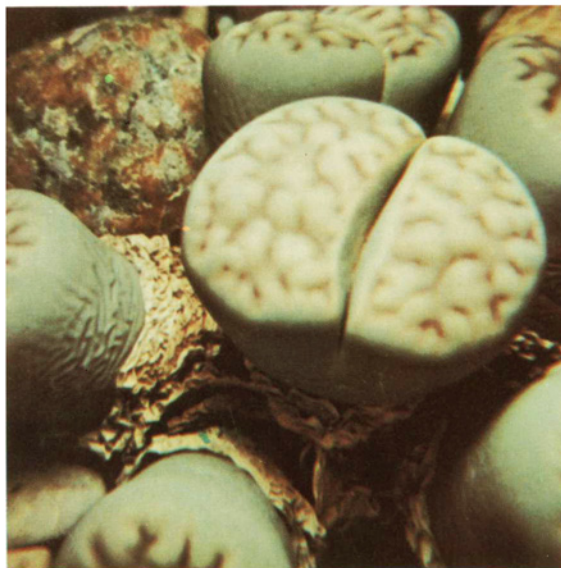
This species was transferred to the genus *Dinteranthus* because of fruit and seed characteristics. It is included herein only to show close relationship and similarity with *Lithops*.

Flowers yellow.

More than three-quarters of the *Lithops* species are found within the water basin of the Orange River and its tributaries. Of these the largest are the Vaal River, flowing westerly in the Cape Province, and the Fish and Mossop rivers flowing south through South West Africa. Above is a view of the Orange River in full flood near Hopetown, Cape Province.



311



312

A white-flowering species, probably a form of *L. erniana*.

About the Authors

David L. Sprechman, who was born in Toronto, Canada, has lived most of his life in Passaic, New Jersey. He attended Rutgers University, from which he received a degree in law. He practiced law in New Jersey and served as a Captain in the infantry during World War II. He has also collected prints and fine art books. At present his entire attention is directed to the collection and study of succulent plants. For more than ten years he has concerned himself exclusively with the genus *Lithops*. Mr. Sprechman has exhibited specimens of his collection at the International Flower Show in New York and has won many high awards. He has lectured on the subject on numerous occasions.

Chester B. Dugdale, now Associate Professor of Biological Sciences at Fairleigh Dickinson University, has been teaching botany and other biological sciences for over twenty years. His articles on *Lithops* have appeared in such publications as *Journal of South African Botany*, *Journal of the Cactus and Succulent Society of America*, and *The New York Times*. Professor Dugdale has also recently traveled to South Africa to collect and photograph *Lithops* at thirty-five habitat sites in the Karoo Desert.

Born in Mafeking, South Africa, in 1922, Desmond T. Cole grew up on a farm on the border of the Kalahari Desert, and there he acquired in childhood his interest in African languages and in nature, particularly birds and succulent plants. After six years of military service in East and North Africa, he returned in 1946 to academic studies at the University of the Witwatersrand, Johannesburg, where he was appointed to the staff as a lecturer in 1949, and as Professor of Bantu Languages and Head of the Department in 1954. Since 1960, his general interest in succulent plants has narrowed its focus to a specialized and intensive study and collection of the genus *Lithops*, in which he is enthusiastically assisted by his wife, Naureen. He has already travelled over 20,000 miles in South Africa and South-west Africa, charting, studying and photographing more than 150 habitat localities, but he considers this to be only the beginning of the survey. Many of his collection of some 1500 color slides of *Lithops* in habitat have been viewed by Cactus and Succulent Societies in Holland, England, and the U.S.A., which Professor Cole has visited on several occasions.

H. W. de Boer of Haren, Holland, was the Dean of those of the world's taxonomists who are working with the genus *Lithops*. He earned this accolade by virtue of his more than 40 years of study of thousands upon thousands of field-collected and seed-grown plants. Upon the background of the knowledge gained from his experience he constructed his *Taxonomic Key to the Genus Lithops* and he named and described many of the species, varieties, and forms depicted in this book. He and his wife were honored by, and will ever be remembered for, two namesake plants: *Lithops deboeri* and *Lithops gesinae*. He died on March 14, 1970 at the age of 85.